833 COMPLAINANT'S EXHIBIT No. 182. James D. Maher, Commissioner.

Sanitary Inspection of Shellfish Grounds.

One of the most important investigations carried on during 1908 and the one requiring the greatest amount of time and attention from the Engineering Division was an examination into the sewage pollution of those waters of the State in which shellfish are grown and matured.

This work, undertaken in accordance with the provisions of section 214 of the Forest, Fish and Game Law, was begun in the latter part of June, 1908, and occupied the time of one engineer and two special inspectors of the division for the greater part of the months of July, August and September. This investigation was made in co-operation with the hygienic laboratory and the work performed by the Engineering Division comprised detailed inspection and the collection of necessary data showing the extent and character of pollution discharged into the streams, bays and sounds of Long Island, comprising some 400 miles of shore line, together with such detailed inspection along the southeasterly shore of Staten Island. In addition to these statistics the location of leased oyster beds was procured from the Department of Marine Fisheries of the Forest, Fish and Game Commission, from the local authorities of various towns along the shores and from the county of Suffolk.

From the information thus collected a set of maps has been prepared showing by an appropriate index pollution data reported by the inspectors together with the location of leased oyster beds. On these maps appear, also, the position and number of the sampling stations from which samples for analysis of both water and oysters were procured and made by the laboratory division.

The results of the investigation have been summarized and described in the following report submitted in accordance with the provisions of the special act to the State Superintendent of Marine Fisheries:

834 ALBANY, N. Y., February 11, 1909.

Hon. B. Frank Wood, Superintendent of Marine Fisheries, Department Forest, Fish and Game, 1 Madison Avenue, New York, N. Y.

DEAR SIR: Section 214 of the Forest, Fish and Game Law requires that reports of the results of inspections of shellfish beds and shellfish made by inspectors of this Department, in obedience to sections 214 and 215 of the same law, shall be submitted to you "immediately."

The person or persons responsible for the drafting of these provisions were possibly under the impression that mere inspection of shellfish beds and the surroundings of the shellfish thereon would give sufficient evidence upon which an opinion as to their sanitary quality, that is fitness for food, could be expressed.

It is unfortunate, but nevertheless true, that such an inspection

as apparently was considered all that would be necessary would be of practically no value in giving results which could be relied upon for the determinations in question.

Only the most exhaustive study of the sanitary conditions of the waters, which might from time to time be over the shellfish beds, and the thorough investigation of all the possible sources of pollution of such waters, together with the determination of all the periodic and special conditions of tides, currents, variations of level, etc., added to and interpreted in the light of the findings of laboratory analyses and examinations of these waters and of the shellfish from these beds, would give any results upon which a satisfactory and fair determination as to sanitary conditions of the shellfish might be based.

Moreover, there is a further difficulty inherent in the State of our scientific knowledge regarding the relation of oysters to the transmission of water-borne diseases, especially typhoid fever. This is that no scientific or administrative body of all those who have made investigations in this direction, even over long periods and with ample scientific assistance, has as yet determined to its satisfaction any definite relation between any estimated pollution of water or of shellfish and the disease-producing liability of the pollution in such water or shellfish.

835 These difficulties, however, did not lessen the efforts put forth by this Department on this work during the last few months, but they have been conducted to the full limit of its capacity, consistent with its other imperative duties. In order, however, that the results may be placed before you in a manner carrying conviction of our earnest desire and intention to fully comply with the law, consistent with a strict adherence to the known scientific possibilities of the situation, an introduction to the main body of the report referring to these difficulties and to our present knowledge on the subject is respectfully submitted.

This introduction deals as briefly and yet as comprehensively as possible with the following subjects:

A. Our knowledge regarding the relation of the occurrence of typhoid and other infectious diseases to the eating of oysters and shellfish.

B. The results and the interpretations of investigations of the sanitary conditions of shellfish grounds, layings, etc., and the shellfish from the same, including the quotation of opinions of scientific workers and commissions regarding the present difficulty, if not impossibility, of fixing standards of pollution upon which condemnations may be based.

A. Relation of Oysters and Shellfish to the Causation of Typhoid Fever.*

Long before the advent of the science of bacteriology there were evidences to show that oysters grown or fattened in sewage-polluted waters were responsible for cases of typhoid fever in those who had eaten these oysters uncooked.

The earliest outbreaks of typhoid attributed to the eating of contaminated oysters were reported in 1816, but few other instances were placed on record until 1880. Since that date a con-
836 siderable number of definite outbreaks have been more or less conclusively shown to have been due to the eating of oysters and shellfish taken from polluted waters. In some places having a high incidence of typhoid fever investigators have attributed a considerable proportion of the sporadic cases of this disease, and in fact some have assigned actual endemic typhoid conditions to the eating of shellfish taken from polluted waters.

Concerning the evidence connecting some of the outbreaks of typhoid fever with the eating of oysters obtained from polluted waters there can be no serious question. That oysters obtained from or which have been "plumped" in sewage-polluted waters have caused outbreaks of typhoid fever is a fact which cannot be gainsaid.

The well-known outbreaks of typhoid fever attributed to oysters in this country occurred at Middletown, Conn., and at Atlantic City.

The Middletown outbreak occurred in the fall of 1894 and was responsible for commanding definite attention in this country to the transmission of typhoid fever by oysters from polluted waters.

The conditions and circumstances under which the outbreak occurred were exceptionally well adapted to prove the possibility and the probability of such transmission following certain lines of oyster industry.

The facts described by Conn* were substantially as follows:

Oysters taken from long Island sound were deposited for a few days, at least, in the tidal waters of Quinnipiac river at Fair Haven, Conn., about 300 feet above the outlet of a private sewer carrying sewage from a house in which there existed two cases of typhoid fever.

Some of these oysters were eaten raw at three separate fraternity banquets at Wesleyan University and served cooked at another fraternity banquet. All of these banquets were held the same evening. Twenty-five per cent. of those attending the three banquets where the raw oysters were served contracted typhoid fever. There

* In the Journal of the Franklin Institute, Vol. CLX, p. 81, August, 1905, Mr. George W. Fuller gives a full account and a very extensive bibliography of Sewage Disposal in Its Relation to the Pollution of Oysters and Shellfish and to the Transmission of Typhoid Fever by the Latter.

An exhaustive report on the same subject is to be found in the Fourth Report of the British Royal Sewage Disposal Commission, Vols. I, II and III.

* Conn. Seventeenth Annual Report, Connecticut State Board of Health, 1894, pp. 243-264.

were twenty-nine such cases. None of those attending the
837 other banquet were affected. There were likewise found two cases among those who had eaten oysters from the same lot in other places in Middletown.

Some of the oysters from the same location at Fair Haven were sent to an Amherst College fraternity dinner, held on the same evening, and six cases of typhoid fever among those attending followed.

No other cases occurred in either of these places which could not be satisfactory accounted for.

The period of incubation and the onset and course of the disease in these cases indicated most definitely a common origin, and there was found no other possible common source but the Fair Haven oysters.

This is a most typical example of the infection of oysters through "plumping" or "drinking" them in water polluted with typhoid discharges. The practice of "drinking" oysters at Fair Haven was not new at that time; the sewer responsible for the infection and other private sewers in the neighborhood had poured sewage into the river for years. The Quinnipiac is likewise polluted by sewage from other sources, but so far as is known the oysters plumped in its waters had not been responsible for a prior outbreak of typhoid fever. However, it would not be proper to infer that oysters plumped in these waters had not been the cause of cases of typhoid fever. Nevertheless, the advent of the two cases to one of the houses sewering into the river near the oyster floats brought about a pollution described by Houston as the most dangerous kind as it was "specific" in character and of "recent sort," although comparatively small in amount.

During the summer of 1902 at Atlantic City, N. J., an unusual number of cases of typhoid fever was noted by the medical profession of that place.

A thorough study of the situation showed that there was no common source for the infection other than oysters and clams. The oysters were found to have been floated in waters at the mouth of the Penrose canal and its vicinity, and this canal was ascertained to be carrying an unusual amount of sewage, owing to a break in the large sewer pipe running in the canal and which conducts
838 under ordinary conditions a considerable portion of Atlantic City's sewage to the "thoroughfare." That the oysters floated and the clams taken from these polluted waters were responsible for a large proportion of the unusual number of cases at Atlantic City there is no doubt. This conclusion was approved by several well-known bacteriologists and epidemiologists who investigated the situation.

In England, in recent years, two extensive outbreaks of typhoid fever, directly attributable to oysters, occurred at Winchester and Southampton from eating of raw oysters taken from lots floated in the proven polluted waters at Emsworth. Here, again, we have to deal with two banquets given on the same day in two separate municipalities, with no possible common source of infection other

than the oysters which were eaten raw. None of the guests contracted the disease except those who had eaten some of the oysters. Approximately, the same percentage of guests contracted the disease and at corresponding intervals. It was likewise found, as in the Middletown cases, that oysters from the same lot brought about infection with the disease among those eating them in other places. It is interesting to note that the oysters had been temporarily deposited in the polluted waters and had not reached maturity at this spot.

In the matter of the causations of sporadic cases and of endemic typhoid conditions by the eating of shellfish, the British Commission on Sewage Disposal obtained the opinions of a large number of well-known English bacteriologists and epidemiologists on the subject. The following are some of the more representative of these opinions, together with the final conclusion of the Commission:

"Dr. J. T. C. Nash.—From special researches made in 1902 into the causation of typhoid fever in Southend-on-Sea, Dr. Nash came to the conclusion that at least 50 per cent. of the cases in that year were due to the consumption of shellfish from sources contaminated by sewage. This, indeed, in his opinion, understates the limit, as he found that out of 105 cases of typhoid fever in that year there was some connection with shellfish in at least eighty-two cases.

"Dr. Nash also quoted figures of typhoid notification in Yarmouth for each month of the years 1897 to 1902. In 1900, after
839 a series of years of endemic typhoid in this town, the sale of mussels from the Yare was stopped, and in 1901, there was a marked reduction in the number of notifications (amounting to 30 per cent. below the monthly means of previous years), and in 1902 a still further reduction.

"Dr. A. Newsholme.—Submitted a tabular statement of the number of cases of enteric fever in Brighton during the years 1894 to 1902, distinguishing those which, in his opinion, were caused by oysters and other shellfish. This table indicates that, out of 643 cases, 158 cases were directly ascribable to the consumption of oysters, and eighty cases to the consumption of other shellfish within the period of incubation. In other words, that 37 per cent. of the total cases of enteric fever during these years were ascribable to shellfish. The history of each case was traced, and cases of typhoid fever were only put down to the shellfish after the apparent exclusion of every other possible cause. The shellfish were traced to particular layings which were proved to be exposed to sewage contamination, and typhoid fever was found to exist among the population draining to the vicinity of the layings. In the opinion of Dr. Newsholme, the extent of the illness attributable to shellfish is understated in the above figures.

"Dr. James Niven.—Submitted a tabular statement of the number of cases of enteric fever in Manchester during the years of 1897 to 1902, inclusive. This table shows that in that period there were 2,664 cases of enteric fever, of which number 274 were associated with the consumption of shellfish, 118 being strictly ascribable to mussels and oysters. In arriving at the latter figure, all other possible causes were considered, and all doubtful cases were rejected. Owing

to gaps in the figures, the number of cases due to shellfish is probably understated.

"Mr. Shirley Murphy.—The information supplied by medical officers of health of metropolitan boroughs tended to show that in 8 per cent. of the cases of enteric fever which occurred in London in 1902, the patient had eaten shellfish at a time before the attack that was consistent with such shellfish having been the cause of the disease. It was not possible, however, to make a definite statement as to what the proportion really was, and Mr. Shirley Murphy was inclined to think that 8 per cent. fell short of the number that
840 would have been obtained if full inquiries could have been made.

"Conclusion of Commission as to Extent of Illness Attributable to the Consumption of Contaminated Shellfish.

"29. After carefully considering the whole of the evidence on this point, we are satisfied that a considerable number of cases of enteric fever and other illness are caused by the consumption of shellfish which have been exposed to sewage contamination; but, in the present state of knowledge, we do not think it possible to make an accurate numerical statement.

"Moreover, an examination of the figures which have been placed before us as regards those towns in which the subject has been most carefully studied shows that there may be occasional errors. Indeed, the witnesses themselves recognized that absolutely accurate figures are not obtainable.

"We are far from denying that isolated cases may have been due to contaminated shellfish, but when we remember the numerous unexplained cases of enteric fever, we feel that the possibility of some of them being due to other causes cannot be altogether excluded."

In this county, opinion on this subject has not become sufficiently crystallized to have brought out many reports of investigation.

The most important is, perhaps, that made by Mr. George A. Soper* regarding typhoid conditions at Lawrence, L. I., in 1904. In this study, the investigator found twenty-one out of thirty-one cases of typhoid fever in which the only probable sources of infection were oysters and clams taken from floats immersed in polluted waters, or from oyster beds subject to pollution. In the majority of cases at least, the oysters were from the floats.

That the waters in which these floats were located were badly polluted was amply demonstrated by the chemical and bacteriological examinations made at a time when conditions were known to be far better than when the cases of the disease developed.

Samples of oysters were likewise examined bacteriologically, and of them 25 per cent. were shown to contain bacteria of the bacillus coli communis type in one-tenth of a cubic centimeter of
841 the shell water, and in 60 per cent. in one cubic centimeter of the same.

The sanitary survey showed the discharge of imperfectly treated sewage, from a population of 15,000, less than half a mile from the

* Soper. Medical News, Vol. 86, 1905, p. 241

oyster floats. In fact, some were very much nearer. Aside from this pollution, there were many individual sewers, manure piles, dump heaps, piles of cesspool sludge, which contributed to the pollution of the water adjacent to the floats.

B. The State of Our Knowledge Concerning the Relation of Qualitative and Quantitative Estimations of Pollution of Water and Shellfish to Disease-producing Liability of the Latter in Man.

From a study of the outbreaks of typhoid fever proven and suspected of being caused by oysters, and of endemic conditions and sporadic cases of this disease caused and suspected of being caused by the consumption of infected shellfish which have been already described, it is apparent that in almost all the instances quoted in the former group, and to a large extent those in the latter, were due to the almost direct carriage of materials of a demonstrated or readily assumed specific infectious typhoid or other disease-producing nature to the shellfish.

The fact that the great danger of the transmission of typhoid fever and other diseases by means of shellfish lies in the character of the materials polluting the beds, drinking places, etc., and in the directness with which such pollution reaches the shellfish, has been well expressed by Hanston in the Fourth Report of the British Royal Sewage Disposal Commission, Vol. I, p. 36, where he is quoted as saying as follows:

"A pollution trivial in amount but specific in character is much more dangerous than a contamination gross in amount but non-specific in nature.

"It is also probable that a pollution trivial in amount, but specific in character and of recent sort, is more dangerous than a pollution gross in amount, specific in character, but of remote kind."

If then the important factors in the role which shellfish play
842 in the transmission of diseases are the character of the materials polluting them and the directness of the pollution, it is manifest that to be in a position to definitely pass upon the disease-producing value of a given growth or lot of shellfish, we must be in a position to determine with accuracy not only the presence or absence of specific disease-producing pollution and also the directness with which such materials will gain access to the shellfish, but also we must be able to express in a quantitative degree the possibility of such specific pollution and the directness of its carriage to the shellfish. Unfortunately neither our systematic supervision of infectious diseases, our methods of sanitary inspection of sewerage and waste disposal systems, nor our technical methods of determining, as a routine procedure, the presence or absence of pollution in water or shellfish, permit us to make definite estimates of the possibility of specific typhoid pollution of shellfish.

To be more explicit on these points, it may be said that while the medical profession and health officers endeavor to prevent undisinfected discharges from typhoid patients and convalescents, from gaining access to sewage and thus to tidal waters, there is no doubt

that such discharges do gain access to such waters with frequency. But how frequently, it is impossible to state.

Typhoid fever is not by any means confined to the larger centers of population with sewerage systems emptying into tidal or other waters. Indeed, the reverse is true. It has been shown by Fulton, Egbert and others quite conclusively that the disease is relatively more prevalent in rural communities. Here individual systems of sewage disposal are in vogue. The greatest danger to a water supply, and by inference to oyster beds, is not, therefore, of necessity due to the presence of sewage from a large community. Most of the outbreaks of this disease due to polluted water have been caused by the improper disposal of the discharges of but one or two cases. This is likewise the case, but to a lesser extent, in the epidemics due to polluted shellfish which have already been described.

However, even a knowledge of the number of cases of typhoid fever among a population using a particular sewerage system permits only approximate estimation of the actual infectious character of the sewage in that system at its outlet. It is well recog-
843 nized that some individuals not sick with this disease harbor and distribute the germs of it in their discharges. Therefore, for this and other reasons the estimation of the amount of sewage leaving a system of disposal is not in reality an accurate index of the "disease value" or infection "possibilities" of that sewage.

Moreover, the laboratory investigations of water sewage and shellfish furnish but little better evidence as to the specific character of a pollution, for the reason that there has never been devised a practical method for the routine determination of the presence or absence of specific disease-producing germs in such materials. All that is now undertaken in such investigations is the determination of the amount of organic matter capable of being used as a bacterial food in the water or sewage, as measured by the number of bacteria present, and the presence or absence and the quantitative estimation of the common sewage bacteria, chiefly and usually only those of the bacillus coli communis type. In other words, the laboratory measures the degree of sewage pollution but not its specific disease-producing character.

The same difficulties which have made impossible for the present the routine examination of water and other liquids for the specific disease-producing bacteria, particularly the typhoid bacillus, have likewise made it most difficult to obtain conclusive results from experiments conducted with the view of showing the fate and the duration of life of the typhoid bacillus in sewage, waters of various types and in the bodies of shellfish. However, a very considerable amount of research has been conducted by bacteriologists toward the settling of the various aspects of this special problem, and the following may be considered a brief but fair general statement of the results:

It may be said that so far as available evidence goes, the living typhoid bacillus does not multiply in either fresh or sea water or oysters under natural conditions.

Whipple has concluded from a study of the literature that the duration of life of the typhoid bacillus in salt water is not unlike that in the fresh. It is generally conceded that the life of the typhoid bacillus in fresh waters of various types is not of long duration, depending upon the action of sunlight, absence of oxygen, antagonism of other bacteria and other physical agencies.

844 Savage has shown that its life in tidal mud, under various conditions, is greater than in water from the same locations, but that, at least, the vast majority of them perish in two to three weeks.

Klein, Field and others have found that typhoid bacilli in live oysters in sea water under certain conditions do not have an indefinite existence but die in considerable numbers, and cannot, in general, be found after a few weeks.

It is, of course, understood that in all such experimental work, the difficulties of isolating typhoid bacilli from fluids containing other bacteria make it possible for some, at least, of the typhoid organisms to have remained alive and to have escaped detection. It can be said also that it is generally conceded that the bacteria of the species type of the bacillus coli communis, the most common form of bacteria found in human discharges, has at least as long a duration of life under most natural conditions as the typhoid bacillus; and that as a general rule it resists the destructive forces of such agencies for a longer period.

For these and other reasons, it must be admitted that the relative numbers of B. coli and other sewage bacteria present in water, milk and other articles of food and drink, gives us indices of a comparative and relative character of the fecal pollution of those articles. While this statement is not likely to be seriously controverted, it must not be forgotten, as we have already indicated, that the degree of pollution, as measured by the relative presence of bacillus coli or coli-like organisms as determined by present methods, is not of necessity an index of the disease-producing power of the polluted article.

From what has been said, it can be properly inferred that the sanitary inspections and the laboratory investigations can give a better idea as to the directness of general sewage pollution than of its specific character, but here again such determinations only have significance as indicative of probabilities and not as certainties in so far as the production of disease is concerned.

The British Royal Sewage Commission in the report already referred to, after carefully weighing a vast mass of evidence, makes the following statement in their conclusions on this aspect of the subject:*

845 "We find it very difficult to state to what extent bacteriology is to be relied on for the purpose of distinguishing those foreshores, pits, ponds, beds or layings from which shellfish are procured, which may be considered safe from those which should be regarded as unsafe, from the point of view of public health.

* Vol. I, p. XXXVI.

"The methods at present available to the bacteriologist do not permit of his detecting, except possibly in very rare cases, the typhoid fever micro-organism either in sewage largely diluted with sea water or in shellfish; neither do they enable him to measure, in any exact manner, whether the micro-organisms which he takes as his index of danger are of recent or remote intestinal origin. Moreover, there is no constant ratio between the numbers of the organism taken as an index and the numbers of the disease-producing organism in the typhoid intestine, in the raw sewage or in the mixture of sewage and estuary water.

"Mere numbers of B. coli or any other particular micro-organism of sewage cannot, therefore, be said to have anything approaching an exact value as an indicator of the danger of disease, and we consider that before any working bacteriological standard can be applied to this problem further knowledge is necessary."

If these statements apply to the bacteriological data, how much more do they generally apply to the results obtained by the less specific methods of measurement of pollution utilized by the sanitary engineer and inspectors.

The limitations of all branches of science in these directions have been summarized by Dr. Houston, the bacteriologist of the British Commission, who has made most exhaustive studies of shellfish pollution, in the following phrase: "Neither the epidemiologist, nor the topographist, nor even the bacteriologist can assign a definite disease value to a given pollution."

It is evident, therefore, that no attempt should be made to pass judgment of condemnation or approval upon shellfish beds and their contents, from the basis of the existence or freedom from disease-producing conditions in them, for we have no method of definitely determining such conditions.

We are forced, therefore, to rely for such action as may be advisable upon the basis of the estimation of the amount and distribution of the sewage pollution of a general character in relation to
846 shellfish beds and their contents, and to oyster drinking places. Nevertheless, making such a basis for action is fraught with no little danger, for the reason that the basis is an artificial one; and on the one hand, it is entirely possible that approval may be given under it to beds, drinking places, and indirectly to oysters and shellfish, which may become the means of transmitting disease; and on the other hand, it is more than likely that beds, etc., may be condemned which are not in reality a menace to health and will not likely become so. In fact, justice to the oyster industry on the one hand, and to the public health on the other, demands that action on this basis shall not be taken except after the most careful and exhaustive investigations of an epidemiological sanitary engineering and biological character.

In order that the opportunities for error and the difficulties of setting up and maintaining such an artificial standard may not be minimized, it is but fair to state that the British Royal Sewage Commission before making their report on the subject had spent about four years in the study of the problems of the pollution of the

oyster beds of the countries of that empire, and that the scientists and medical officers of health who testified before the Commission or worked under their direction had in some cases been debating and investigating the subject for ten years. It was the opinion of the Commission and of the scientific workers that they had not yet sufficiently covered the ground to warrant the establishment of a standard of pollution sufficiently definite for the condemnation or certification of the insanitary or sanitary condition of oyster and shellfish beds and shellfish.

The Massachusetts State Board of Health likewise spent four years in the study of the pollution of Boston harbor before they undertook to prohibit the taking of shellfish from most sections of it, and even when such action was taken they did not refer to any definite standards as a basis for their decision in the matter.

For this Department to attempt to fix standards of pollution for condemnation after a few months' work, with no adequate financial support, and a field for investigation almost equal in area and importance to that covered by the British Commission investigation, would indeed be presumptive.

It can be said, however, that the results obtained by the
847 sanitary survey and the biological investigations of the laboratory, both of which must be considered in the light of preliminary studies, exhibit a very fair degree of harmony. This harmony would appear to indicate that a more satisfactory basis for drawing conclusions as to the relative pollution of a general character of the various locations might be obtained by more thorough studies which could be made if proper resources are provided.

Sanitary Survey of Shellfish Grounds.

The engineering work undertaken in the investigation comprised the collection of data and the preparation of maps to show:

I. The character, amount and points of discharge of all pollution received by streams, tidal rivers, bays and sounds which might cause contamination of shellfish.

II. The location of all leased oyster beds and the waters from which oysters and clams are taken for market.

III. The estimated yearly output of marketable and seed oysters and of clams from each district or shipping point.

IV. The general direction of tidal currents in Jamaica bay, with reference to the principal points of pollution, by a short series of float experiments, together with the determination of the tidal prism in Jamaica and Raritan bays.

The method of procedure and the work accomplished under each of the foregoing headings will be described in detail.

I. Collection of Data Regarding Pollution.

Complete data were secured by personal inspection made by inspectors from this Department as to the pollution of all streams,

tidal rivers, bays and sounds which might affect the shellfish industry carried on in waters adjoining Long Island and Staten Island comprising all oyster cultivation districts within New York State.

The data thus collected describes, it is believed, all public and private sewers and overflow pipes from cesspools discharging into such waters, and all outside privies located near the bank of streams and bays, together with other special conditions, such as the character and amount of wastes from manufacturing plants and the location of refuse dumps, which might contaminate such waters.

848 All municipalities were visited and practically a house-to-house canvas was made along the shores and streams of Long Island from College Point on the East river easterly to Orient Point, Riverhead and Montauk Point, and thence westerly to Coney Island, comprising some 400 miles of shore line; such inspection was also made along the shores of Staten Island from the Narrows westerly to Tottenville, and northerly to Linoleumville. In addition, data was obtained as to the sewage pollution from New Jersey municipalities discharged into Raritan bay, Shrewsbury river, Raritan river, Rahway river, West brook and Arthur kill.

In this work of inspection to determine pollution, the data collected included: (*a*) The location or point of discharge of all public and private sewers, cesspool overflow pipes, outside privies and sewers carrying wastes from factories; (*b*) the number of persons served by each sewer or sewer system; and (*c*) the date of construction, when available, of each sewer and sewer system.

This data was recorded in daily reports of inspectors made in duplicate on blanks numbered to correspond to numbers shown on inspector's maps. In order to be able to show graphically on maps the results of the sanitary inspection a numerical system was adopted as follows: A number was assigned to each stream, bay or locality, and the points of pollution were numbered on maps to correspond to the numbers on inspectors' reports. The character of the pollution is indicated by a decimal number affixed to the number assigned to the locality—.1 indicating a public sewer system outlet; .2 indicating a private sewer; .3 indicating an overflow pipe from a cesspool; and .4 indicating an outside privy over the water or in such a location as to pollute the water. Subnumbers indicate the number of separate cases of sewers, privies, etc., in each locality or on each stream or bay. For instance, 109.2, indicates eight private sewers discharging into the stream assigned the number 109, and 109.3, indicates eight cesspool overflow pipes discharging into the same stream. In some instances individual cases of pollution were indicated by letters, for instance, 260.2^a, and 260.2^b indicates two private sewers discharging at separate points into the same stream.

The daily reports of inspection, signed and dated by the inspector, are numbered to correspond to the numbers on the map indi-

849 cating pollution, and give further detail of such pollution.

These reports of sanitary inspection appear in this report as Appendix II. The pollution data given in the inspector's daily reports is summarized for fourteen separate oyster cultivation districts

and appears, together with the results of sanitary analysis of water and oysters, in Appendix I to this report.

The inspectors' maps, for use in the field work, were made up by mounting and folding the Atlas sheets of the United States geological survey covering the entire tidal waters of New York State, from Arthur kill to Fishers island. From these maps and from maps of the United States coast and geodetic survey tracings and prints have been made to accompany this report, and will be found in Appendix I and III.

Much valuable assistance was rendered during the investigation by health officers and other public officials of various towns and villages.

II. Location of Oyster Beds.

Maps showing the location of all oyster beds leased by the Marine Fisheries Department of the New York State Forest, Fish and Game Commission, by the various towns in Nassau and Suffolk counties, by the county of Suffolk, and by the heirs of the Smith Estate (in Great South bay) were obtained or traced from existing maps and these bed locations were transferred to one of the inspectors' maps. No maps of oyster grounds in Manhasset bay on the north side and Hempstead bay on the south side of Long Island were available, and the map of oyster beds in Great South bay, leased by the town of Islip, did not show the location of the beds in relation to the shore lines. However, in these three instances the approximate location and extent of the beds were obtained from oyster commissioners and oystermen and are shown on the maps. The location and extent of all leased oyster beds, with notes as to natural growth oyster grounds, are shown, therefore, on the maps appearing in Appendix I and III, although it was found that the use of many of the beds had been discontinued in some localities.

The oyster beds leased by the State comprise all beds in Jamaica, Raritan, East Chester and Pelham bays, and those in Long Island sound which lie outside the bays and harbors. In general, all other oyster beds in New York State are leased by the towns in which they lie, except that the beds in the Peconic bays, Gardiner's bay, and Shelter Island sound are leased by the county of Suffolk, and except that certain beds in Great South bay from Nicholas Point eastward to Bayport, included in the towns of Islip and Brookhaven, are leased by the heirs of the Smith Estate. The locations of oyster beds in Jamaica and Raritan bays were taken from prints furnished by the New York city health department made from tracings of the maps on file in the Bureau of Marine Fisheries.

The location and extent of the leased oyster beds in the fourteen oyster cultivation districts in New York State are described in detail in Appendix I of this report.

III. Statistics Showing Yearly Output of Shellfish.

The United States Bureau of Fisheries in the last published "Statistics of the Fisheries of the Middle Atlantic States" reports that in 1904 the total yield of shellfish from New York State waters was as follows:

Oysters, 3,329,332 bushels, valued at $3,780,352, of which 2,868,507 bushels were market oysters and 460,825 bushels were seed oysters.

Hard clams, 167,992 bushels, valued at $303,599.

Soft clams, 74,993 bushels valued $95,400.

Scallops, 148,799 bushels, valued at $145,646.

Skimmers or surf clams, 11,510 bushels, valued at $6,720.

Mussels, 15,910 bushels, valued at $4,590.

In the same report it is stated in relation to the oyster industry in New York State: "The increase in the value of the products (of all fisheries) from $3,894,270 in 1901 to $6,230,558 in 1904 is due principally to the extension and success of oyster culture. In 1904, 2,847,792 bushels of market oysters were taken from the private areas and only 20,805 bushels from the natural reefs, a remarkable exhibition of the development of the cultivated grounds. As regards the value of the output, New York is now the foremost American State in oyster culture. The recent growth of this industry has been especially extensive at the eastern end of Long Island. Previ-
851 ous to 1900, oysters shipped from that region were planted elsewhere before marketing but in recent years they have been permitted to remain until large enough for market. Of the market oysters credited to the private areas of the State, 378,410 bushels, worth $404,135, and of the seed oysters 46,150 bushels, worth $39,670, were taken up by vessels owned in Connecticut and elsewhere outside of New York."

The total output of market oysters for 1904 from the Middle Atlantic States—New York, New Jersey, Pennsylvania, Delaware, Maryland and Virginia, was 14,429,974 bushels as given by the Bureau of Fisheries at Washington.

In connection with the sanitary inspection, estimates were secured when possible of the probable output of market oysters, seed oysters and clams from each locality. The data thus collected appears on the inspectors' reports and is summarized for each district in Appendix I.

IV. Determination of Tidal Currents and Volumes.

But little time was available during the investigation to carry out float experiments for the purpose of determining the direction and velocity of tidal currents as relating to the distribution of sewage in waters in which oysters are grown. However, a series of float experiments was made, extending over a period of ten days, to determine the probable course followed by sewage and sewage disposal plant effluent discharged at four of the principal points at which Jamaica bay receives pollution.

It should be stated that the determination of tidal currents and velocities, if definite results are to be obtained, requires that an extended series of float experiments and calculations covering a considerable period of time should be carried on under varying conditions of tide and winds.

The points at which floats were liberated were at the Sheepshead Bay sewage disposal plant outlet near Plum Beach channel; at the point of outlet of New Lotts sewage disposal plant northeast of Canarsie; at Bergen creek which receives the effluent from the Jamaica sewage disposal plant; and at various points in Beach channel along Rockaway Beach.

From what little information could be obtained in the ten
852 days during which experiments were carried on, as to the direction and velocity of tidal currents in Jamaica bay, it would seem probable:

1. That effluent from the Sheepshead Bay sewage disposal plant, discharged at flood tide, passes into the upper reaches of Plum Beach channel northwesterly from its junction with Broad creek, and that effluent from this plant, discharged at ebb tide, passes out of Rockaway inlet only through Plum Beach channel and Dead Horse inlet.

2. That effluent discharged from the New Lotts sewage disposal plant at the beginning of ebb tide follows a course to points opposite Canarsie Landing, keeping from 100 to 1,500 feet off shore during this course, and from Canarsie Landing gradually swings out into a deeper channel east of Bergen beach reaching points from 1,000 to 2,000 feet east of Bergen beach in about three and one-half hours.

3. That effluent from the Jamaica sewage disposal plant reaching Bergen Creek during the beginning of ebb tide passes westerly of the Rockaway Beach railroad being 1,000 feet or more off shore at this point. This effluent then swings southerly into Pumpkin Patch channel and the adjacent channel to the west.

4. That sewage discharged into Beach channel during flood and during the last of the ebb tide from various points along Rockaway beach has a tendency to hug Rockaway beach shore during the corresponding flood tide. But that sewage discharged into Beach channel during the first part of the ebb, though passing along the Rockaway beach shore during the ebb, becomes disseminated across the channel during slack water and the beginning of flood tide, and is then carried back through Beach channel, or northeasterly up through the various other channels.

Tidal Volumes.

The tidal prism of Jamaica bay inside of Rockaway point and the Sheepshead bay breakwater was obtained by measuring the area of the bay on the United States coast and geodetic survey maps. The area of the bay, exclusive of marshes, is 16,690 acres. The mean range of tide is 4. feet. So that the total volume of tidal water passing in and out of the bay twice each day is, roughly, 2,900 million cubic feet.

853 Similarly the tidal prism of Raritan bay, Sandy Hook bay and that included portion of lower New York bay lying westerly from a line drawn from Sandy Hook beacon to Fort Tompkins light is, roughly, 11,500 million cubic feet, the area being 56,620 acres and the mean range of tide 4.7 feet.

Extended field work and studies are needed to determine the direction, volume and velocity of tidal currents in these and other waters of the State in which shellfish are grown and matured.

The Bacteriological Investigations of Shellfish Grounds.

These investigations consisted in the following undertakings:

1. The general survey and study of the oyster industry in the various localities in the State, and consultations with representative scientific workers in shellfish bacteriology, oysters growers, health officers, and others interested, in order to form a proper conception of the problem as a whole.

2. The inauguration of a central laboratory for the conduct of the biological researches as to relative pollution of the waters in the vicinity of oyster beds, and of oysters.

The general survey comprised visits to the oyster beds and consultations with representative oyster growers and health officers in the vicinity of Raritan, Jamaica, East Chester, Great South, Huntington and Oyster bays, and in the district comprising Peconic bay, Shelter Island sound and Gardiner's bay.

Much general and considerable detailed information regarding the oyster and clam industries was obtained, and led to decisions as to the course of the investigations finally followed.

It was ascertained that to attempt to undertake the investigation of the natural hard clam beds and their contents would be to so divide the available energies that only very unsatisfactory and incomplete results could be obtained from either the investigation of the oyster beds and oysters or that of the clam beds and clams. As the clam industry represents less than 1 per cent. of the volume of that of the oyster, it was deemed best to defer the study of the clams and their surroundings until a later period.

It appeared from the knowledge obtained during this general survey that oysters in Raritan and Jamaica bays finished spawning earlier than those in other sections of the State. In conse-
854 quence, these oysters were found to arrive at a marketable condition in advance of others. It was, therefore, believed that it would be easier to obtain samples of oysters in proper physical condition from these locations earlier in the season than from other sections. Moreover, the size and importance of the industry at these two points, and the apparent proximity of these locations to the large centers of population, led to the decision to make as extensive investigations in these two sections as the facilities and time at our disposal warranted.

It was likewise decided to undertake the examination of samples of water and oysters to be taken from other locations, selecting as far as possible such as would be most likely to show the more serious

pollutions and those which might reasonably be suspected of freedom from pollution.

The collection of samples was commenced the latter part of July and continued until October 1st.

The oyster samples were, in large part, collected through the courtesy of the various oyster producers by the sanitary chemist of the State Hygienic Laboratory, and the data regarding the locations from which they were collected and the conditions of collection are as complete as it was possible to obtain them with the facilities at hand.

The total number of samples of all kinds examined was 332. Of these, 128 were of water and 204 were of samples of oysters. In all 926 oysters were subjected to bacteriological examination.

The Bacteriological Study of Oysters and Their Surroundings.

The detailed results of these laboratory investigations in each of the fourteen oyster cultivating districts will be found in association with results of the sanitary surveys of these districts.

Descriptions of methods employed:

a. The oysters were first cleaned and a spot near the hings on the shell was sterilized by heat. With a drill sterilized by heat, a hole was drilled partly through the upper shell. The place where the hole was partly drilled was again flamed, as was the drill, and then the hole was drilled completely through the shell. This made it possible to draw off the shell water with a pipette from a point near the oyster's mouth.

855 *b.* As a test for bacilli of the B. coli type, the shell water was then inoculated into Jackson's bile media, and from the bile tubes which showed fermentation, lactose litmus agar plates were made and slants were made from typical colonies.

The results of tests for bacilli of the B. coli type shown in the tables of the Appendix are presumptive, as in only a few instances were confirmatory tests made from the agar slants.

The results that were obtained by confirmatory tests were generally positive.

The samples of water that were examined were also inoculated into Jackson's bile media. Early in the investigation it was found that bacilli of the B. coli type were so prevalent in the shell water of oysters taken from certain localities when 1 c. c. of the shell water was inoculated, that it was realized that there would be few quantitative distinctions, unless different volumes of the shell water *was* inoculated from oysters taken from a given place.

c. Afterward different volumes of the shell water were inoculated in the bile tubes; but because it was necessary to minimize the amount of work, the volumes taken of oysters from given localities were varied according to the location, and the conclusions derived from a knowledge of the locality.

In places where the sanitary survey indicated that the oysters might be more seriously polluted, 1/10 and 1/100 c. c. inoculations

were made. From four to six oysters from a given bed were usually examined.

Approximate quantitative B. coli type results were also obtained upon the samples of water from the oyster beds by inoculating different volumes in a similar manner.

On the water samples, bacterial counts were made upon standard gelatin incubated for forty-eight hours.

Comments upon the Results of the Sanitary Examinations and the Bacteriological Investigations.

In view of the statements made under sections A and B in the preliminary remarks of this report, it must be manifest that even if the investigations here reported had been carried out over a period of years and with the greatest care allowed by our present scientific methods, it would not be possible to draw conclusions as
856 to the presence or absence of disease-producing power of the oysters from the results here reported.

As has been stated, while the results of the field and the laboratory work are in close harmony, the studies can only be considered as preliminary, and as such the Department is not warranted in passing final judgment on the results for the purpose of administrative action. This does not carry with it, however, the necessity for refraining from the tabulation of the results on the basis of the relative conditions as found.

Certain workers in bacteriology have undertaken to classify the results of the examination of oysters by groups, and have referred to the results placed in certain groups as being subject to degrees of pollution.

Thus Houston* in his published article on shellfish pollution outlines six groups on the basis of his findings of bacillus coli communis in the whole oyster.

The table expressing these groups is here reproduced, and in its provisions and statments gives a tabulated conception of the whole problem of the fixation of standards.

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* Houston. Journal of Hygiene. 1904. Vol. 4. p. 182.

† It must, of course, be definitely understood that it cannot be said that oysters of Class II or even Class I are necessarily always safe, or that oysters of Class III–VI have a definite "disease value."

No. 1. To obtain approximate results per c.c. of oyster, divide the foregoing figures by ten.

No. 2. The approximate results per c.c. of oyster have been computed and expressed in terms of volume of oyster in which B. coli is present are here inserted in brackets in Dr. Houston's table.

No. 3. This does not mean administrative, practical or legislative condemnation, but only that the evidene of pollution is sufficiently defined to merit objection from the bacteriologist's point of view.

No. 4. As regards tests (1), (2), (3) and (4), my work for the Local Government Board on the B. coli of recently voided normal human faeces shows that of 100 B. Coli, 98, 92, 98 and 92 per cent. yielded positive results in each instance to one or other test. As regards all four tests (taken in conjunction) 85 per cent. yielded positive results.

Bacteriological Grouping of Oysters.

Class.	Standard based on numerical abundance of B. coli (or non-liquefying, gas-forming coli-like microbes), in the whole contents of the oyster shell (i. e., liquor, body and interior juices of the oyster).
I.	
An oyster showing no evidence (bacteriologically) of objectionable contamination.	No B. coli.
II.	
An oyster showing appreciable, although slight, evidence (bacteriologically) of objectionable contamination.	1 B. coli per oyster No. 1. No. 2 (approximately, B. coli in 10 c. c. of oyster).
III.	
An oyster, showing definite signs (bacteriologically) of pollution and, therefore, possibly to be viewed with some degree of suspicion.	10 B. coli per oyster No. 1. No. 2 (approximately, B. coli in 1 c. c. of oyster).
857 IV.	
Stringent standard: An oyster showing such obvious signs (bacteriologically) of pollution as to be condemned on a stringent standard.	100 B. coli per oyster No. 1. No. 2 (approximately, B. coli. in 1/10 c. c. of oyster).
V.	
Lenient standard: An oyster showing such unmistakable evidence (bacteriologically) of pollution as to be condemned on the basis of results No. 3.	1,000 B. coli per oyster No. 1. No. 2 (approximately, B. coli in 1/100 c. c. of oyster).
VI.	
An oyster showing such gross evidence (bacteriologically) of contamination as to be outside the pale of recognition.	10,000 B. coli per oyster No. 1. No. 2 (approximately, B. coli in 1/100 c. c. of oyster).

In Classes with Tentative.

Numerical standard confirmed or modified according to response of the coli-like microbes in pure culture to certain well-known biological tests:

For example:
(1) Neutral-red broth test—
Greenish-yellow fluorescence (48 hours at 37° C).
(2) Lactose peptone test—
Gas and acid productions (48 hours at 37° C).
(3) Indol test—
Indol in broth culture (5 days at 37° C).
(4) Litmus milk test—
Acid clotting of milk (5 days at 37° C).

Of course, the more tests applied, the better, but the above are all known tests of value No. 4.

858 Standards for Comparative Purposes.

Provisional bacteriological conclusions confirmed or modified by topographical observations.	Provisional bacteriological and topographical conclusions confirmed or modified by epidemiological and administrative considerations.
For example: Dilution: set of the tides; prevailing winds; float experiments; time interval; distance, etc., etc.	For example: Questions of practicability; whether the contaminating material is likely to have a high or a low enteric morbific value; past epidemiological experience in circumstances broadly parallel, etc., etc.

For the purposes of comparison, we may take the work conducted under the direction of the Massachusetts State Board of Health,* which has already been referred to. As has been stated, this work was in progress for several years. The only instance of the condemnation of any location as a source for the production of shellfish by this Board is that of Boston Harbor. It is of interest, therefore, to note the results of the sanitary survey and of the examination of shellfish and water from the same, and the grounds upon which the condemnation was made.

The sanitary survey showed that approximately 170,000,000 gallons of sewage were poured into the waters of the harbor at three points daily, and that also a considerable amount was contributed at a large number of other points, but no estimates of those amounts

* 37 Annual Rept. Mass. State B. of Health, 1905. p. 16, 411-58.

were given. It should be stated that 100,000,000 gallons of the sewage is sent out to sea with the outgoing tides. Nevertheless, it is stated that the waters of the harbor are subject very generally to considerable pollution. Apparently were it not for the marked purifying action of the tides, the harbor would soon be in an intolerable condition. However, it is stated in the report that the incoming tide returns none of the previous outgoing pollution with it.

859 Regarding the laboratory examinations of the water and shellfish, the report is not specific as to the exact bacteriological methods used in the tests. In the key on the map are the statements that the results for the tests on the clams are B. coli in 1 c. c. of the shell water or in the body of the clam. No figures are shown, however, on the map, the results being indicated by + or 0 signs, indicating, respectively, the presence or absence of B. coli presumably in 1 c. c.

In the table on page 424, the results are given in terms of samples containing various sewage bacteria in either shell water or the bodies of the clams, presumably again in 1 c. c. Examining these results, we find out of 125 samples of clams examined all but twenty-nine showing the presence of either B. coli or sewage streptococcus in either the shell water or body of the clams, and in only four instances were there less than 50 per cent. of the samples from a given place showing these bacterial evidences of pollution. In only fifty-six samples out of 125 were B. coli found in the shell water of the clams. It should be stated, however, that in the work reported in other parts of this volume, there are statements leading to the conclusion that in many shellfish from the most polluted sources the B. coli were not to be found in the shell water or the body of the clams. In such locations the usual presence of streptococcus gave indication of the possible overgrowth of B. coli by the latter. As this is an experience which we did not note in our work, it is possibly due to a difference in the methods employed.

Taking all these facts into consideration, it might be arbitrarily assumed, merely for the purpose of comparison of results between the various workers, that the condemnation limit, as far as bacteriological work is concerned of the Massachusetts State Board of Health were probably not far from the presence of the B. coli type in 1 c. c. of the shell water of shellfish examined.

In the report of the bacteriological examination of oysters of Narragansett bay, conducted by Mr. C. A. Fuller for a period of three years, the author draws distinction between those containing B. coli in the shell water or body of the oysters and those which do

860 not. He speaks of the former as polluted, and the latter as not polluted. He makes no attempt at quantitative examinations of the B. coli content of either the shell water or of the various portions of the body of the oysters examined. However, it is a fair inference that quantities less than 1 c. c. must of necessity have been used by him in the tests of the intestinal and visceral content of the oysters. This might well account for his finding B. coli less often in the oysters than in the water over the oysters. In the water exam-

inations from which he drew his conclusions as to the presence or absence of pollution, his analyses were of 1 c. c. samples.

It can properly be assumed, merely for the purpose of comparison, that a maximum limit which would fairly represent the views of this worker would be the presence of B. coli in 1 c. c. of either tidal water or the shell water of the oyster.

In the report of Soper on the typhoid conditions at Lawrence, he mentions oysters showing a presumptive test for B. coli in 1 c. c. of the shell water as probably polluted, and those showing B. coli in the same way in 1/10 c. c. as definitely polluted. This latter would correspond somewhat to Houston's stringent standard.

In order to compare the results obtained by our own investigation from the various locations with each other according to these various tentative and presumptive standards of the authors quoted, the following table has been prepared.

The plus (+) indicates that if such standards as have been here attributed to the various authors were applied to the results obtained by us and were to be accepted as a basis for condemnation, the oysters from that section would come under the ban. The minus (—) sign indicates that the reverse would be the case.

It would not be proper for us to assume that the authors under consideration would be willing to assume responsibility for the application of these standards in such a manner, but the table serves well to illustrate the fact that while diversity of opinion may exist in different locations, according to variations in the presenting problems, there is not so great a general divergence from the different standards as might be expected.

861 *Tabulation of Results of Laboratory Investigations of Oysters According to the Assumed Standards of Various Investigators.*

Source of Oysters.	Massachusetts.[1]	Fuller.[2]	Houston.[3]	
			Stringent.	Lenient.
No. 1.				
Rodmans Neck	+	+	+	—
City Island	+	+	+	—
Davids Island	+	+	+	—
East Chester Bay (water only)	+	+	+	—
Island Bridge	..	..	—	—
No. 2.				
Manhasset Bay	+	+	..	..
No. 3.				
Hempstead Harbor	+	+	..	..
No. 4.				
Long Island Sound	—	—	..	..
Oyster Bay	+?	+	—?	..
Cold Spring Harbor	+?	+	..	..
No. 5.				
Huntington Harbor	+	+	+	—
Northport Bay	+	+	..	..
Huntington Bay	+	+	+	—

Source of Oysters.	Massachusetts.[1]	Fuller.[2]	Houston.[3] Stringent.	Houston.[3] Lenient.
No. 6.				
Nissequogue	+?	+	..	..
No. 7.				
Port Jefferson Harbor	—	+?	..	..
No. 9.				
Greenport Harbor	+	+	+?	..
Mattituck	+	+	..	..
Sag Harbor	+	+	—?	..
No. 11.				
Howell Point	—	+	..	..
Patchogue	+	+	+	+?
Blue Point (One sampling point)	—	—	..	..
Green Point	—	+	..	..
Nichols Point	—	+	..	..
Islip	—	+	..	..
No. 12.				
Freeport	+	+	+?	..
Milburn	+	+	—?	..
East Rockaway	+	+	..	..
No. 13.				
Old Mill Pond	..	..	—	..
Flat Lands Bay	+	+	—?	..
Big Channel	+	+	+	+
Beds near Rockaway and trestle	+	+	+	+
Ruffle Bar	+	+	—	—
Big Fishkill Channel	+	+	+	+?
Pumpkin Patch Channel	+	+	+?	—
Goosekill Creek	+	+	—	—
Raunt	+	+	—	—
Big Channel (Old Swale Marsh)	+	+	+?	—
Island Channel	+	+	—	—
No. 14.				
Raritan Bay (Great Kills and vicinity)	+	+	+?	—?
Southwest of Great Kills	+	+	+?	—

[1] Massachusetts. Assumed Massachusetts State Board of Health standard for condemnation = Bac. coli type present in 1 c. c. volumes of shell water of 50 per cent. of samples examined.

[2] Fuller. Assumed standard of C. A. Fuller, Rhode Island Investigation = B. coli present or absent in 1 c. c. volumes of tidal water or oyster shell water as indicative of the presence or absence of sewage pollution.

[3] Houston. Presumptive stringent and lenient standards of Houston. It should be stated that Houston's technic and methods of expression of results as indicated in the table quoted from his work are not those used by us, and it would not be possible to interpret our results in the terms used by him with absolute accuracy. He examined the entire contents of the oyster shells, while we examined only the shell water. Broadly speaking, however, we may reasonably assume that his stringent standard would be about equivalent to the finding of B. coli in .1 c. c. of shell water and his lenient standard to the same finding in .01 c. c. of the same.

862 It must be remembered that the above interpretations have been based upon the results of laboratory analyses alone and have not been considered in relation to the important factors involved in the "Sanitary Survey," the information and bearing of which have always been taken regularly into account by all commissions and other official bodies which have worked on this problem and have had to assume the responsibility of drawing conclusions and making recommendations for official action. In fact, when we stop to consider the indefinite nature of the evidence furnished by laboratory analyses alone, of the minute quantity of the samples of water or portion of a single oyster selected for examination, of the transitory and variable conditions represented by each sample at the time of collection, and other similar indeterminate factors which, as pointed out above, are involved in giving to such results a "disease value," it is clear to us why these commissions and official bodies have always laid special stress upon the importance of the "Sanitary Survey" and why for practical purposes, and in order to afford a basis for official action, they have given equal consideration if not precedence to the results of the "Sanitary Survey."

It is, further, quite essential that there should be no misunderstanding as to the magnitude and scope of the engineering field work properly included under the conventional designation of "Sanitary Survey," and to the difficulty of securing without more extended and full series of observations, covering a wide range of physical phenomena, the data to make this survey complete. The velocity and direction of tidal currents under variable conditions of winds; absolute and relative volume of sewage as compared with the fresh water and tidal prisms; ratios of dilution of sewage and tidal water; effects of sedimentation and scour; temperatures and densities of the sewage, fresh water and salt water in relation to stratification; the period of time elapsing during passage of sewage from sewer outfalls to oyster beds or drinking grounds; are all important factors generally embodied in the "Sanitary Survey" which have a direct or indirect bearing upon the problem, and without which an interpretation of analytical results alone would be almost meaningless.

863 It must be evident, then, that an investigation full enough to secure all of the necessary laboratory and engineering data and to satisfactorily solve all of the questions upon which can be based proper and consistent official action relative to the oyster beds and tidal waters in the vicinity of New York and Long Island is a task which it has been impossible to complete in the limited time and with the limited force of laboratory and engineering division assistants available. That a considerable and valuable amount of work has been accomplished by these two divisions along bacteriological and engineering lines, as outlined above, is true, but it is also a fact that, owing to the lack of any provision in the act, under which this investigation was required, to provide the necessary funds to carry out the investigation, it has been performed with no little sacrifice to other important work of the Department;

and that it will be necessary to continue this investigation with a more adequate force of expert assistants, and with more adequate funds, if the problem is to be solved with that definiteness and completeness assumed in the requirements of the act.

What has been accomplished so far is, however, of a permanent character, permanently recorded, and is of such nature as to form a basis of extended and more elaborate work that must inevitably be carried on in the future if rational and consistent official action is to be taken according to the provisions of the act. In the meantime, and pending this further investigation, it is manifestly fitting and desirable that no efforts be relinquished along that course which is not overshadowed by questions or uncertainty and doubt, of remedying or removing any conditions surrounding the oyster beds and waters adjacent to New York bay and Long Island, which may be a direct menace to health or by the removal of which the continued use of any particular oyster bed affected thereby may be more safely permitted.

Power is granted under section 207 of the Forest, Fish and Game Law, whereby criminal action can be taken by you against any one allowing sewage to pollute any oyster bed or beds, and the State Department of Health has also jurisdiction, under the law of 1903, over any additional pollution of the public waters which did not exist at the time the law was passed.

The policy of the State Department of Health since 1905 has been that further and unrestricted pollution of the waters of the State should cease and, insofar as the Department had the
864 power, the existing discharge of raw and ineffectively treated sewage should as rapidly as possible be prohibited.

Active work along these lines has been conducted by the State Department of Health on Long Island since the passage of the law of 1903, and its efforts will be vigorously continued, with the expectation of rapid improvement in existing conditions.

Very respectfully,

EUGENE H. PORTER,
Commissioner of Health.

865 APPENDIX I.

Summary of Pollution Statistics Reported by Sanitary Inspectors, Together with Description of Extent and Character of Shellfish Industry by Districts in New York State, with Results of Sanitary Analyses of Water and Oysters.

Oyster Cultivation Districts in New York State.

1. East Chester and Pelham district.
2. Manhasset bay.
3. Hempstead harbor.
4. Oyster bay district, including Cold Spring harbor and the sound from Matinicock Point to Lloyd Point.

5. Huntington bay and harbor and Northport bay district, including the sound off Eatons Point.
6. Smithtown bay.
7. Port Jefferson harbor district, including sound from Crane Neck Point to Mount Misery Point.
8. Along north shore of Long Island from Mt. Sinai harbor to Orient Point.
9. Peconic bay, Shelter Island sound and Gardiner's bay district.
10. Moriches and Shinnecock bay districts.
11. Great South bay, from Babylon to Patchogue.
12. Hempstead bay, from Far Rockaway to Seaford creek.
13. Jamaica bay.
14. Raritan bay.
(Maps numbered 6, 8-9-10, 13 and 14 are in Appendix III.)

1. East Chester and Pelham Bay District.

This district extends from Throgs Neck and Pelham Bay park on the west to Hart and Davids islands on the east, including the oyster grounds off Elm Point and Hewlett Point on Great Neck, and comprises the head of Long Island sound.

Formerly the greater portion of lower East Chester bay was under cultivated, but mud deposits have greatly interfered with
866 the industry so that the only areas of considerable size that are now planted lie north of Locust Point and south of Rodman Neck.

With respect to tidal conditions it may be noted that the flood tide coming up the East river apparently meets the flood coming up the sound near Throgs Neck, so that it is not likely that sewage from New York city and from the northerly sections of the borough of Queens reaches these beds.

The local pollution consists principally of the sewage discharged into Hutchinson river and canal from the city of Mt. Vernon and the villages of Pelham and Pelham Manor, and of sewage discharged into East Chester bay and the sound from City island.

Sewer systems serving 26,000 persons discharge into Hutchinson river and canal while about 700 persons are served by short individual and party sewers on City island.

From Throgs Neck and Willets Point westerly, considerable sewage is discharged into the sound and into the East river, although, as pointed out, this does not reach the beds under ordinary tidal conditions. From Fort Schuyler on Throgs Neck and Fort Totten on Willets Point, sewage from the garrisons of several hundred men is discharged into the sound. From Whitestone, three main sewer outlets, serving a portion of a population of 3,200 in the locality, discharge into the East river.

At Whitestone, also, twenty-one private sewers discharge into the water, and nine privies were so located as to cause pollution.

At College Point sewage from a population of about 9,000 persons is discharged into the East river.

On Little Neck bay, one semi-public sewer serving thirty houses,


NEW YORK
STATE DEPARTMENT OF HEALTH
EUGENE H. PORTER M.D.
Commissioner
SHELLFISH INVESTIGATION
1908.
Scale: 1/62,500.
1 mile.
LEGEND:-
Leased Oyster Bed.
00.1 Public sewer system outlet
00.2 Private sewer outlet
00.3 Cesspool overflow pipe outlet
00.4 Privy
Number to left of decimal is No. of inspector's report.
00.1 Water Sampling Station
Ebb Tide when sample was taken
Flood
00.2 Oyster Sampling Station.
Number to left of decimal is No. of Sanitary Analysis
Flushing
College Point
Whitestone
Bayside
Little Neck
New Rochelle
Hutchinson River
Pelham Bay
East Chester Bay
City Island
Fort Schuyler
Willets Pt.
Little Bay
True Meridian
1

twenty-two private sewers, two overflows from cesspools and eight privies contribute pollution to the waters, representing sewage discharge from 310 persons in all.

On Great Neck from Hewlett Point to Elm Point, thirty private sewers serving 150 persons discharge into the sound, together with one overflow pipe from a septic tank serving two houses.

(Here follows exhibit marked No. 1.)

867 *Oyster Cultivation District No. 1.*

East Chester and Pelham Bay.

	Sample number.	Bacteria per c. c. 20° C.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.	0.001 c. c.
Rodmans Neck...	137.2	....	....	....	1+3—	0+4—	....
	262.2	....	....	....	2+3—	0+5—	....
	174.2	....	....	....	2+2—	0+4—	....
	179.1	425	0+2—	1+1—	0+2—	....	....
City Island.....	175.2	....	....	....	1+3—	1+3—	....
	176.1	30	0+2—	0+2—	0+2—	....	....
	176.2	....	....	....	2+2—	0+4—	....
	177.2	....	....	....	2+2—	0+4—	....
Davids Island ..	178.1	1,100	0+2—	0+2—	0+2—	....	....
	178.2	....	....	....	3+1—	0+4—	....
East Chester Bay	256.1	1,700	....	....	1+1—	0+2—	0+2—
	257.1	11,500	....	....	2+0—	0+2—	0+2—
	258.1	2,100	....	1+1—	1+1—	0+2—	....
	259.1	2,200	....	....	2+0—	0+2—	0+2—
	260.1	30	....	0+2—	0+2—	0+2—	....
Island Bridge....	261.1	250	....	....	0+2—	0+2—	0+2—
	263.2	....	....	....	0+5—	0+5—	....

In the tables of analytical data, the sample numbers terminating in .1 are water samples.

Those numbers terminating in .2 are numbers referring to oysters.

The + sign indicates the presence of the B. coli type.

The — sign indicates that the B. coli type was absent.

2. Manhasset Bay.

The only oyster beds under cultivation in this bay lie near Plum Point and Tom Point, about a mile west of Port Washington.

The principal points where pollution occurs are near Port Washington and at the head of the bay.

The pollution consists of discharge from private sewers, overflow from cesspools and from privies located either over the water or near the water.

In the vicinity of Port Washington and in the village, from Barker Point to the southerly limits of the village, nine private sewers and thirteen privies pollute the bay with sewage and wastes from about 200 persons, two of the sewers being hotel sewers.

From the east side of the bay south of Port Washington
868 and from the entire west side of the bay, sewage is discharged from thirty private sewers, while six overflowing cesspools, ten privies and ten households at the time of inspection were polluting the waters. Total population represented is 280.

There are several beds in the sound off shore from Manhasset Neck, from Barker Point to Mott Point. The sewage discharge along this section is very light and consists of six private sewers and two overflowing cesspools.

Oyster Cultivation District No. 2.

Manhasset Bay.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli.			
			10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Manhasset Bay ..	220.1	550	0+2—	0+2—	0+2—	....
	220.2	....	....	8+0—	....	....
	221.2	....	....	4+0—	....	....
	222.2	....	....	4+0—	....	....
Port Washington.	223.1	45,000	2+0—	0+2—	0+2—	....

3. Hempstead Harbor.

This district includes from Mott Point to Weeks Point. The oyster beds are located from Bar Beach, near Glenwood Landing, south, and lie along the harbor a little west of the center. The annual output is about 30,000 bushels. The greatest pollution received by the bay comes from the village of Glen Cove, and reaches the bay through Mosquito Cove about one mile in from the sound. Along the west side of Hempstead harbor from Mott Point to Bar Beach eight private sewers and three privies pollute the waters of the harbor.

Around both sides of the harbor south of Bar Beach, twenty private sewers and twenty-one privies were found to pollute the waters, the greatest concentration being along the ponds in the village of Roslyn. The pollution, therefore, south of Bar Beach, consists of sewage and wastes from about 200 persons, although only half of this is direct.

From Glenwood Landing, opposite Bar Beach, to Weeks Point, including the villages of Sea Cliff and Glen Cove, there are
869 four party sewers serving forty-four houses, although sixteen of these houses discharge wash water only. Also, a sewer from the Ladue leather belting works in Glen Cove takes the sewage from 500 employees.

There are also sixty-three private sewers, two overflows from cesspools, one from a boarding-house property accommodating seventy persons, and seventy-one privies which contribute to the pollution. This gives a total of 955 persons served by sewers discharging directly into the harbor along this section, overflows from cesspools receiving sewage from seventy-five persons and privies so located as to pollute the waters either directly or indirectly, used by 350 persons.

Oyster Cultivation District No. 3.

Hempstead Harbor.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Hempstead harbor	225.1	650	....	0+2—	0+2—	....
	225.2	....	....	4+0—	....	....
	224.2	....	....	4+0—	....	....
	223.2	....	....	4+0—	....	....
	227.1	500	....	0+2—	0+2—	....
	227.2	....	....	1+3—	....	....
	228.2	....	....	3+1—	....	....

4. Oyster Bay District, Including Cold Spring Harbor and Long Island Sound from Matinicock Point to Lloyd Point.

From Matinicock Point to Lloyd Point, many acres of beds are located for the whole distance along the sound, except at the entrance to Cold Spring harbor. In Oyster Bay harbor the beds lie on three sides of Center island and do not lie so close to the shore of the main land as to Center island. Beds are located entirely across Cold Spring harbor just inside of Rocky Point, and a series of beds lie close to the west side of Cold Spring harbor from Cooper's Bluff southward.

The pollution from Matinicock Point and Dosoris pond to Rocky Point at the entrance to Cold Spring harbor is very slight
870 and is caused by the discharge of seven private sewers and five overflowing cesspools distributed along a stretch of seven or eight miles.

Oyster Bay harbor receives some pollution, there being 250 persons served by forty-nine private sewers discharging into the harbor, twelve overflowing cesspools, and twenty-six privies so located as to cause direct or indirect pollution, so that at present the harbor receives pollution from about 450 persons. The greatest concentration occurs on the creek flowing through the village, there being twenty-one privies polluting this stream besides two private sewers and one overflowing cesspool. The greater portion of this pollution is permanent.

Cold Spring harbor from eighteen private sewers receives sewage from a population of 125 persons, nearly all of which is discharged at the head of the harbor. In addition there are fifteen privies so located as to pollute the waters.

There are extensive oyster beds, mostly for seed oysters located off Llyod Point, the only local pollution being from two privies.

(Here follow Exhibits marked No. 2 and No. 3.)

NEW YORK
STATE DEPARTMENT OF HEALTH
EUGENE H. PORTER, M.D.
Commissioner

SHELLFISH INVESTIGATION
1908

Scale: ~~1/2,500~~

1 mile

Exhibit No. 182

Oyster Cultivation District No 4.

Oyster Bay District, Including Cold Springs and the Sound from Matinicock Point to Lloyd Point.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Long Island Sound	311.2	....	....	0+4—	....	....
	310.2	....	....	1+3—	....	....
Oyster Bay	300.2	....	....	2+2—	....	....
	313.1	1,200	....	0+2—	0+2—	....
	301.2	....	....	1+3—	....	....
	303.2	....	....	4+0—	....	....
	304.1	600	0+2—	0+2—	0+2—	....
	304.2	....	....	2+2—	....	....
	305.1	....	....	....	....	....
	305.2	....	....	4+2—	0+6—	....
	306.2	....	....	1+3—	....	....
	302.2	....	....	3+1—	....	....
	309.2	....	....	1+3—	....	....
	307.2	....	....	2+2—	....	....
	308.2	....	....	0+4—	....	....
Cold Spring Harbor	241.1	80	2+0—	2+0—	0+2—	....
	239.2	....	....	2+2—	....	....
	240.2	....	....	1+3—	....	....
	237.2	....	....	1+3—	....	....
	238.2	....	....	3+1—	....	....

871 5. Huntington Bay and Harbor and Northport Bay District, Including the Sound off Eaton Point.

The oyster beds in this district are located principally in Huntington bay and the northeasterly portion of Northport bay and in the sound northeast and northwest from Eaton Point. A few beds lie in Lloyd harbor, just inside the entrance to Huntington harbor, and a few are located at the entrance to Centerport harbor. There are approximately 200,000 bushels of marketable oysters shipped with barrels from Northport each year, principally to Norwalk and other Connecticut points. Three of the largest seed oyster dealers ship 1,500 bushels per year. No "drinking" is done in this section.

In Lloyd harbor the pollution is caused by two private sewers, serving twenty-eight persons, and a privy at the Lloyd harbor lighthouse, serving five persons.

In Huntington harbor the pollution occurs principally at the head of the harbor, and consists of discharge from twenty-two private sewers serving 220 persons in summer and from 75-100 in winter. Seven of these sewers carry sink drainage only, but the 220 persons stated are served by the remaining fifteen sewers. An 18-inch outlet from the gashouse carries the waste from the process. In addition there are two overflow pipes from cesspools, and three cases of cesspools from which seepage reaches the harbor. One of the direct overflows from a cesspool is at the yacht club. Also seven privies, used by about thirty-five persons, and two house boats directly pollute the waters.

An effort is being made to establish a sewer system in the village of Huntington, and the Huntington Association is carrying on an active campaign to free the waters of the bay and harbor from pollution.

In Huntington bay the discharge from three direct sewers carries sewage from 125 persons. A large summer hotel, with a transit population of from 500–1,000 on special days, is provided with a septic tank and subsoil irrigation system. But at the time of inspection the irrigation system was not properly operated, so that the discharge consisted of septic tank effluent. The pollution of Huntington bay is largely diminished in the fall and winter.

872 On Eaton Point only one privy was found to pollute the waters. Centerport harbor receives sewage contributed by thirty persons through three private sewers. In addition, three sink drains serving a population of 140 persons, and two overhanging privies pollute the waters. This discharge is almost entirely at the head of the harbor.

Northport bay receives sewage pollution from 1,300 persons through thirty-seven private sewers, and two public sewers. In winter this estimate is reduced somewhat, and in summer the sewage from the 525 pupils and teachers in the public school included in the estimate does not reach the bay. In addition, one cesspool, receiving sewage from ten persons in summer only, overflows into the bay, and seven overhanging privies directly pollute the water.

The greater portion of sewage discharged into Northport harbor comes from the village.

(Here follows Exhibit marked No. 4.)

4

NEW YORK
STATE DEPARTMENT OF HEALTH
EUGENE H. PORTER, M.D.
Commissioner

SHELLFISH INVESTIGATION

Scale: 1/62,500. 1908

1 mile

LEGEND.

- Leased Oyster Bed
- 001 Public sewer system outlet
- 002 Private sewer outlet.
- 003 Cesspool overflow pipe outlet
- 004 Privy.

Number to left of decimal is No. of Inspector's report. Sub No. gives total No. of cases.

- ○ - 001 Water Sampling Station
- ● Ebb Tide when sample was taken
- ● Flood " " "
- ○ - 002 Oyster Sampling Station.

Number to left of decimal is No. of Sanitary Analysis.

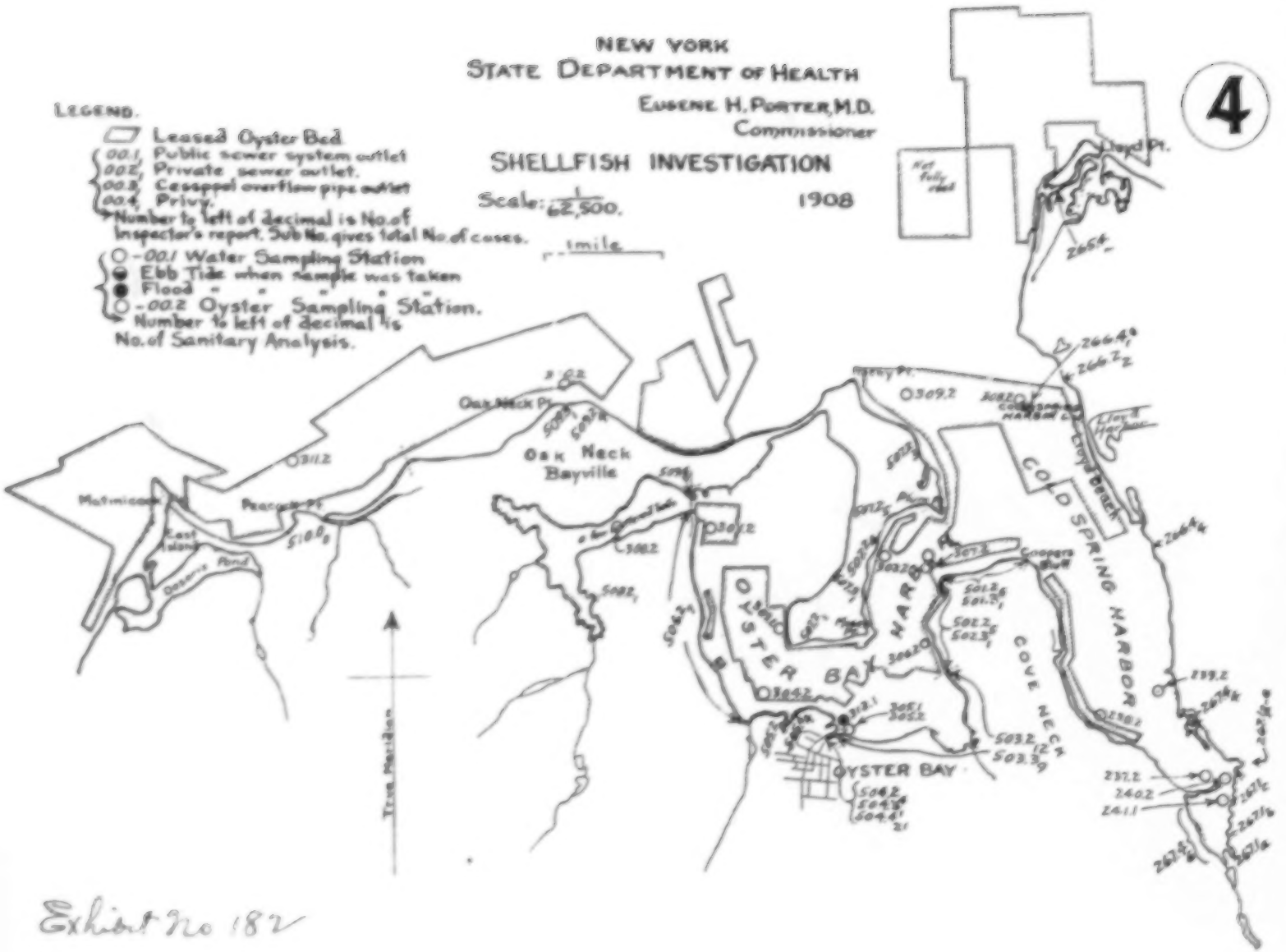


Exhibit No 182

Oyster Cultivation District No. 5.

Huntington Bay and Harbor and Northport Bay District, Including Sound off Eaton's Point.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Huntington Harbor	314.1	4,200	2+0—	2+0—	2+0—	....
	315.1	350	2+0—	2+0—	0+2—	....
	316.1	750	1+0—	2+0—	0+2—	....
	317.1	850	1+1—	0+2—	0+2—	....
	318.1	450	....	0+2—	0+2—	....
	266.1	475	1+1—	0+2—	0+2—	....
	318.2	....	....	4+0—	....	....
	266.2	....	....	....	2+4—	0+6—
Northport Bay...	246.1	7	0+1—	0+2—	0+2—	....
	246.2	....	....	1+3—	....	....
	244.1	4,000	0+2—	0+2—	0+2—	....
	244.2	....	....	4+0—	....	....
	243.1	475	0+2—	0+2—	0+2—	....
	243.2	....	....	3+1—	....	....
	247.1	27	0+2—	0+2—	0+2—	....
	247.2	....	....	4+0—	....	....
	245.1	320	0+2—	0+2—	0+2—	....
	245.2	....	....	1+3—	....	....
Huntington Bay..	267.1	210	2+0—	0+2—	0+2—	....
	267.2	....	....	6+0—	5+1—	....
	268.1	275	0+2—	0+2—	0+2—	....
	268.2	....	....	6+0—	6+0—	....
	269.1	3,500	0+2—	0+2—	0+2—	....
	269.2	....	....	1+5—	0+6—	....

873 6. Smithtown Bay.

In Smithtown bay, extensive oyster beds are located from about three-eighths of a mile to a mile off shore west of the Nissequogue river, while east of this river the beds lie close to the shore, commencing a half mile east of the river and extending for over two miles. Practically no pollution of the waters of the sound occurs except near the Nissequogue river.

At East Beach near Northport bay, one direct sewer and one privy pollute the waters.

A short distance west of the Nissequogue river the main sewer from the Kings Park Hospital discharges, carrying sewage from 4,000 inmates and attendants. The nearest beds lie, as previously mentioned, about one-half mile from this sewer and from the mouth of the Nissequogue river.

At the mouth of the Nissequogue river, a sewer from the laundry at the Kings Park Hospital, carrying laundry waste only, discharges.

The Nissequogue river is polluted by sewage from eight private sewers serving a population of seventy-five persons, by seven sink drains, by one overflow from a cesspool and by three privies, the greater amount of this pollution being discharged into the head waters of the river.

Through Porpoise channel and Stony Brook harbor, Smithtown bay receives pollution at the extreme eastern end by discharge of sewage into the above-named waters from seven sewers, serving sixty-three persons. Fourteen sink drains and eleven privies also pollute the waters of Porpoise channel and Stony Brook harbor.

The nearest oyster beds to the outlet of Porpoise channel lie three-quarter mile to the west and one-quarter mile off shore.

(Here follows Exhibit marked No. 5.)

873

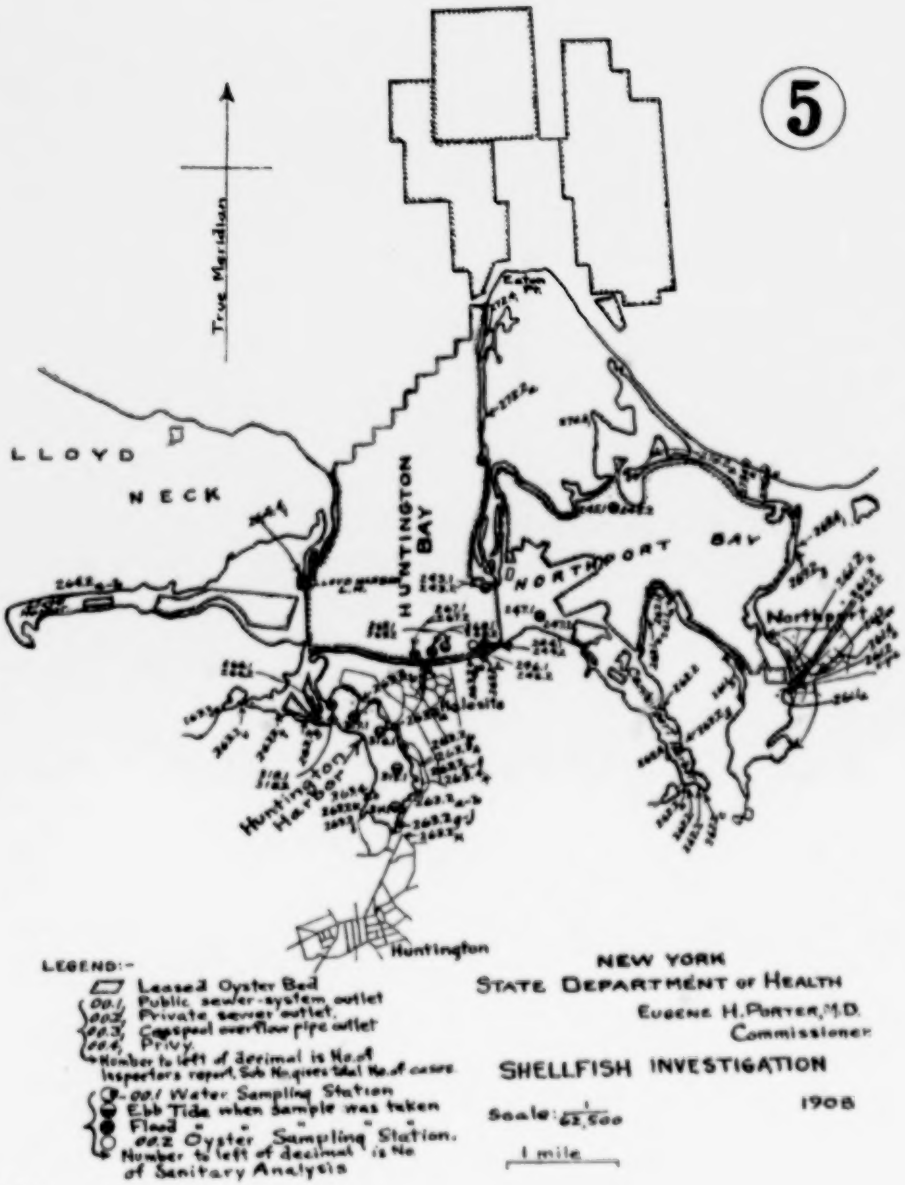
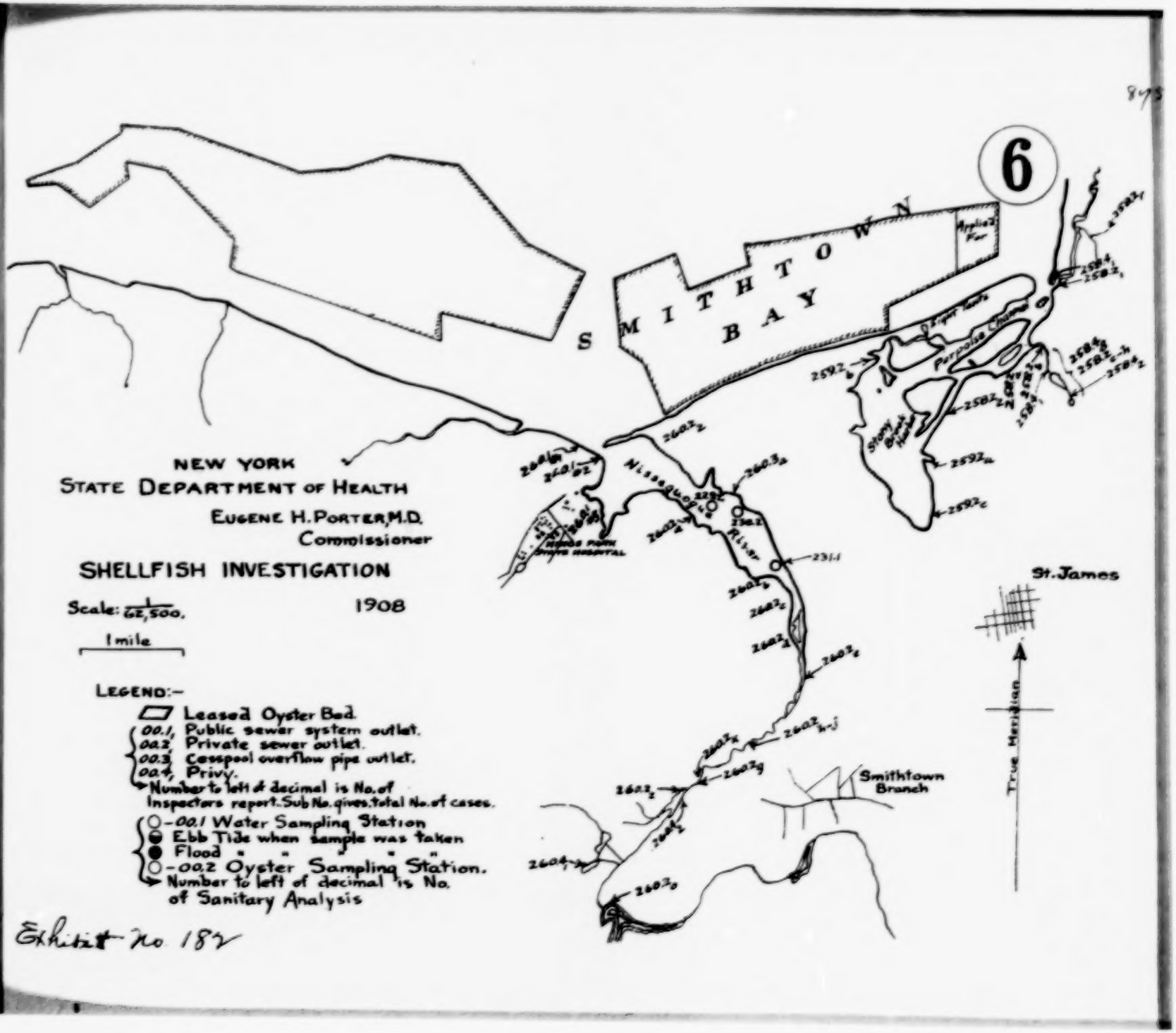
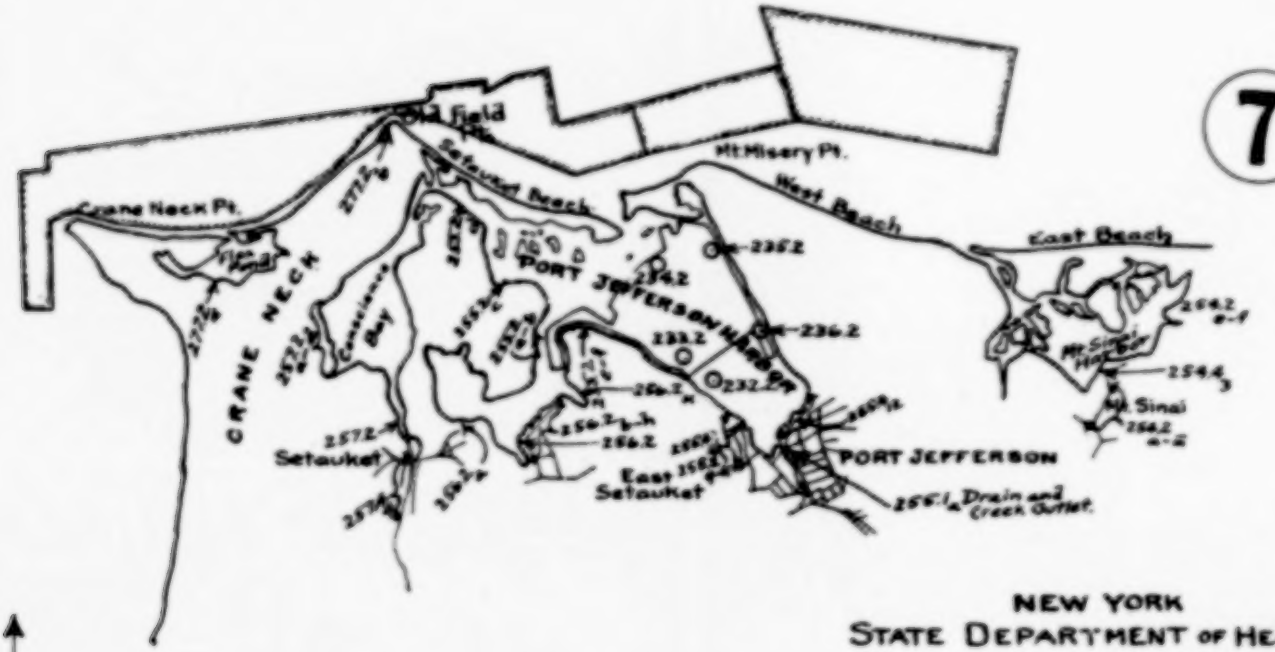


Exhibit No 182


6
NEW YORK
STATE DEPARTMENT OF HEALTH
EUGENE H. PORTER, M.D.
Commissioner
SHELLFISH INVESTIGATION
Scale: 1/62,500.
1908
1 mile
LEGEND:-
Leased Oyster Bed.
00.1, Public sewer system outlet.
00.2, Private sewer outlet.
00.3, Cesspool overflow pipe outlet.
00.4, Privy.
Number to left of decimal is No. of Inspectors report. Sub No. gives total No. of cases.
-00.1 Water Sampling Station
Ebb Tide when sample was taken
Flood " " " "
-00.2 Oyster Sampling Station.
Number to left of decimal is No. of Sanitary Analysis
SMITHTOWN BAY
Smithtown Branch
St. James
True Meridian
Exhibit No. 182

7



NEW YORK
STATE DEPARTMENT OF HEALTH
EUGENE H. PORTER, M.D.
Commissioner

SHELLFISH INVESTIGATION

Scale: 1/62,500 1908.

1 mile

LEGEND:-

- Leased Oyster Bed.
- 00.1 Public sewer system outlet
- 00.2 Private sewer outlet.
- 00.3 Cesspool overflow pipe outlet
- 00.4 Privy
- Number to left of decimal is No. of Inspector's report. Sub No. gives total No. of cases.
- -00.1 Water Sampling Station
- Ebb Tide when sample was taken
- Flood " " " "
- -00.2 Oyster Sampling Station.
- Number to left of decimal is No. of Sanitary Analysis

Exhibit No. 187

Oyster Cultivation District No. 6.

Smithtown Bay.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Nissequogue River	229.2	.....	.....	4+0—	2+1—	.....
	230.2	.....	.....	1+3—	0+6—	.....
	231.1	525	.....	0+2—	0+2—	.....

874 7. Port Jefferson Harbor District, Including the Sound from Crane Neck Point to Mt. Misery Point.

The oyster beds in this district lie along the sound shore and in the central portion of Port Jefferson harbor. Practically no pollution of the sound exists except one direct outlet into Flax pond serving five persons, and one sink drain, at Oldfield Point. Into Conscience bay, five direct outlets discharge, serving a population of thirty persons, while four overhanging privies pollute the bay.

The pollution of the westerly portion of Port Jefferson harbor adjoining Setauket beach and the village of East Setauket consists of sewage discharged through twelve private sewers serving seventy-five persons. There are also three sink drains which discharge into this section. Only four of these private sewers are near oyster beds.

The pollution which reaches the easterly section of Port Jefferson harbor comes from the village of Port Jefferson at the head of the harbor, one-half mile from the nearest oyster beds, and consists of sewage discharged from twenty-five direct sewers leading to the main creek, which serve as sewers for a population of 300 persons.

Of the twenty-five direct sewers, five are from hotels. In addition, twelve sink drains discharge into this creek.

Along this stream ten overhanging privies cause pollution of the waters, and two livery stables drain washings into the stream.

On the southeasterly portion of the harbor, twelve overhanging privies discharge into the water, and on the westerly side of the harbor, three direct sewers, one sink drain and four overhanging privies, all within the village, pollute the waters. The total pollution of the harbor, therefore, from Port Jefferson village is represented by the sewage and waste from 450 persons, and is fairly constant throughout the year.

875 *Oyster Cultivation District No. 7.*

Port Jefferson Harbor District, Including the Sound from Crane Neck Point to Mt. Misery Point.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Port Jefferson Harbor	234.2	.....	.....	0+4—	.....	.....
	235.2	.....	.....	1+3—	.....	.....
	233.2	.....	.....	1+3—	.....	.....
	232.2	.....	.....	0+4—	.....	.....
	236.2	.....	.....	1+3—	.....	.....

(Here follow Exhibits marked No. 6 and 7.)

8. Along North Shore of Long Island from Mt. Sinai Harbor to Orient Point.

There are only two small groups of beds in this district. One of these groups lies off Hashamomuck beach and extends from a mile to two and one-half miles east of Horton Point. The other group lies between Rocky Point and Terry Point opposite Orient harbor. Some oystering is carried on in Mattituck inlet.

Application has been made to the Marine Fisheries Bureau for oyster grounds in much of this section but such grounds are not in use, the lease having been granted subject to examination for natural growth.

Four hundred and fifty bushels of oysters per year are shipped from Mattituck.

The pollution is inconsiderable along the entire sound front.

In Mt. Sinai harbor, six sink drains discharge at various points and three overhanging privies pollute the waters at points remote from oyster beds.

Three overhanging privies pollute the waters of Wading river.

At Waterville on Mattituck inlet one drain from sinks and urinals at a hotel and one overhanging privy discharge into the inlet.

About one-half mile east of Horton Point, two cesspools receiving sewage from seventeen persons overflow into the sound, and between this point and Inlet point there is one private sewer serving nine persons.

876 At Truman Beach, one private sewer discharges one-quarter mile from the oyster beds, and at the west end of the beach, at St. Thomas summer recreation home accommodating 120 children at a time, kitchen wastes only are discharged into the sound.

Oyster Cultivation District No. 8.

Along North Shore of Long Island from Mt. Sinai Harbor to Orient Point.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli.			
			10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Mattituck	329.2	.....	.....	6+0—	.....	.....
	330.2	.....	.....	4+2—	.....	.....

9. The Peconic Bays, Shelter Island Sound and Gardiners Bay.

This district comprises the arm of the ocean included between the two easterly peninsulas of Long Island.

The beds in these waters are leased by the oyster commissioners of the county of Suffolk. Leased oyster beds occupy the greater portion of the bottoms of the bays, the only lands not leased lying under the central portions of Great Peconic bay and Little Peconic bay, nearly all of Noyack bay, the central portion of Gardiners bay and narrow strips along the shores of the bays, which are held as natural beds. Seed oysters, principally, are taken from the beds in this district.

The principal points from which these waters receive pollution are

Riverhead, Greenport, Shelter Island Heights, and the Manhanset house on Shelter Island, and Sag Harbor on the south shore of Shelter Island sound.

At Riverhead, two public sewers and one private sewer discharge sewage from a maximum of 475 persons, although this number probably falls to about 300 after the summer season. Along the Peconic river as it passes through Riverhead and the immediate vicinity, fifteen privies are so located as to pollute the stream
877 to some extent. The overflow from one cesspool reaches the waters of Flanders bay.

The oyster beds nearest Riverhead lie opposite the village of South Jamesport, four and one-half miles from the village of Riverhead.

From South Jamesport along the northwesterly shores of the Peconic bays and Shelter Island sound to the village of Greenport, very little pollution is added to the waters. Two miles east of South Jamesport one cesspool overflow pipe discharges into Great Peconic bay at a point about a mile distant from the leased beds. At New Suffolk, two cesspool overflow pipes and one sink drain discharge into the bay during the summer months.

The Standard Oyster Company at New Suffolk ship about 1,000 bushels a day during a portion of the season.

At Southold, two sink drains and one private sewer discharge into an arm of Southold bay.

Near Conkling Point a privy at a brickyard discharges on ground flooded at high tide.

At the village of Greenport, west of Fanning Point, two private sewers, serving nineteen persons, discharge into Pipes cove. From Fanning Point to the railroad dock six private sewers serving thirty persons discharge into Greenport harbor. A public sewer, with several laterals, discharges at the end of the ferry slip at the foot of Main street in the village of Greenport. The maximum number of persons served by this sewer system is 1,580, and varies somewhat since a school building, accommodating 600 pupils, is connected, as well as three hotels having a combined guest capacity of 130. Six overhanging privies pollute the waters at the shipyards along the water front.

Four party sewers, serving a population of 250–280, discharge into Stirling basin.

There is but one oyster-house in Greenport, and from 45,000 to 60,000 bushels per year are shipped from this house. "Drinking" at this house is done in private ponds of spring water.

Opposite Conkling Point and Greenport, Shelter Island sound receives sewage from Shelter Island as follows:

At Jennings Point, and south of Jennings Point, Shelter
878 Island sound receives sewage from thirteen private sewers serving sixty-five persons. These are mostly from summer cottages.

From Shelter Island heights the association sewer discharges at a point 500 feet from shore, and the maximum number of persons served by this sewer during the summer months is 1,050. This

number is largely reduced after the summer season. In addition, three private sewers, serving seventeen persons, discharge into Derring harbor.

The Manhanset House sewer, serving as a maximum 570 guests and attendants, discharges under the steamboat dock 200 feet out from shore.

On the east side of Derring harbor, the sewage from twenty-three cottages is discharged into two large cesspools having overflow pipes reaching seventy-five to one hundred feet into the harbor. This represents a discharge of sewage, or cesspool overflow, from 115 persons during the summer months.

Orient harbor receives sewage at points remote from oyster beds from three private sewers serving fifteen persons and one sewer serving fifteen persons and one sewer from a hotel having 100 guests.

A boarding-house near Long Beach bay discharges sewage into the bay.

Along the south shore of the Peconic bay, Noyack bay and Shelter Island sound very little sewage is discharged into the waters, except at Sag Harbor. One cesspool with an overflow pipe discharges into Little Peconic bay at Nyack.

At Sag Harbor, two public sewers and two private sewers discharge sewage from 715 persons into Shelter Island sound inside the breakwater. The above number includes the employees at a watch case factory and a maximum guest capacity of three hotels.

At North Haven, a private sewer discharges into the sound, and from the south shore of Shelter Island, three private sewers, serving fifteen persons, discharge into swamps and bay.

879 *Oyster Cultivation District No. 9.*

Peconic Bay, Shelter Island Sound and Gardiners Bay District.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Sag Harbor.....	333.2	.....	.....	0+6—	.....	.....
	334.2	.....	.....	6+0—	.....	.....
	335.2	.....	.....	5+1—	.....	.....
	335.1	140	0+2—	0+2—	0+2—	.....
	336.2	.....	.....	0+3—	0+6—	.....
	336.1	.....	0+2—	0+2—	0+2—	.....
	337.1	800	2+0	0+2—	0+2—	.....
Greenport Harbor	320.2	.....	.....	4+2—	.....	.....
	321.1	.....	0+2—	0+2—	0+2—	.....
	321.2	.....	.....	3+1—	1+3—	.....
	322.1	400	2+0—	2+0—	2+0—	.....
	322.2	.....	.....	3+1—	2+2—	.....
	323.1	250	0+2—	0+2—	0+2—	.....
	323.2	.....	.....	2+2—	0+4—	.....
	324.2	.....	.....	2+2—	.....	.....
	325.2	.....	.....	3+1—	.....	.....
	326.2	.....	.....	4+0—	.....	.....
	327.2	.....	.....	1+3—	.....	.....
	328.2	.....	.....	1+3—	0+4—	.....

10. Moriches and Shinnecock Bays.

No oystering on a commercial scale is done in these waters. Moriches bay is in general too shallow for oyster culture. There are no leased or cultivated grounds in Shinnecock bay, although many natural beds are found in both the east and west portions of this bay. A few natural growth oysters are found in Mecox bay, also.

Some pollution of the waters occurs around Moriches bay. One cesspool overflows into Forge river. Five cesspool overflow pipes discharge into the bay and tributary streams east of Masury Point, two of these leading from boarding-house properties or hotels. At West Cove, one direct sewer from a cottage, and one overflow pipe from a cesspool from a summer hotel having a capacity of 100 guests discharge into the water. At Hart's Cove the overflow from a cesspool at a hotel having a capacity of eighty persons discharge into the water, as well as the overflow from a cesspool at a summer school accommodating 250 persons.

Duck farms on Terrell river, Hart's Cove, and on Seatuck creek pollute the waters.

One private sewer and one cesspool overflow pipe discharge
880 into Seatuck creek. There are also duck ranches on Speonk river and at Tanner Neck. Practically no pollution of the waters occurs from this point eastward along the shores of Long Island to Montauk Point.

Oyster Cultivation District No. 10.

Moriches and Shinnecock Bay District.

No samples taken.

11. Great South Bay from Babylon to Patchogue.

The principal sections of Great South bay in which oysters are cultivated on leased lands lie from a point opposite Bay Shore for a distance of ten miles eastwardly to Bayport. A few beds are cultivated in the vicinity of Oak Island. From Nichols Point westward the beds in this district are leased by the oyster commissioners of the town of Islip. From Nichols Point eastward to Bayport, including portions of the bay which lie in the town of Islip, and portions which lie in the town of Brookhaven, the beds are leased by the heirs of the Smith estate. Easterly from this point, in the town of Brookhaven, no beds are leased by the town, but much natural growth occurs in the vicinity of Patchogue. Areas are leased by the oyster commissioners of the town of Brookhaven on the bay front at Patchogue, for the purpose of storing oysters for the winter market. The oyster grounds in Great South bay are maturing grounds and furnish the famous Blue Point oyster.

The principal shipping points are at Bay Shore, West Sayville,

Sayville and Patchogue. In a normal year over 700,000 bushels are shipped from the first three points named. From one-third to one-half of these oysters are opened at the houses.

There are no public sewer systems discharging into Great South bay. Some slight pollution of the westerly portion of the bay and its tributary streams occurs along the shore from Amityville to Bay Shore. The principal pollution along this district occurs at Babylon where a party sewer serves one hotel and six houses.

At Bay Shore, Penataquit creek, at the mouth of which are located three oyster-houses, receives pollution from four
881 private sewers, eighteen overflow pipes from cesspools and twelve privies, Bay Shore creek receives pollution from ten cesspool overflow pipes and six privies. Four cesspool pipes in each case discharge into Great cove and Champlin creek. Nichols bay and the Connetquot river receive pollution from six overflow pipes from cesspools.

At West Sayville no direct pollution occurs.

Opposite Sayville three overflowing cesspools discharge directly onto the beach or into the bay. Along the west side of Browns creek eight privies are so located on marsh land that some pollution at extremely high tide is possible. One cesspool discharges into this creek. At Browns Point four privies are located on land subject to overflow at ordinary high tide. One of these adjoins an oyster float basin and undoubtedly pollutes the water.

From the shore opposite Bayport and Blue Point, two private sewers and four cesspool overflow pipes pollute the bay.

Patchogue creek receives considerable pollution. A main sewer which drains the business portion of the village receives sewage from two hotels and about forty houses. A sewer from the lace mill discharges direct and receives sewage from 150 of the employees, while the sewage from 350 of the employees passes through cesspools. Manufacturing waste from this mill is also discharged into the creek. A sewer from a lumber yard discharges sewage from 200 employees. Two hotels discharge cesspool overflow into the bay, and one hotel, having a capacity of 200 guests, discharges sewage directly into the bay. Cesspools at the Patchogue Yacht Club overflow into the bay. In addition, four private sewers, and four overflow pipes from cesspools at individual houses contribute pollution to the bay.

Patchogue bay, therefore, is polluted either directly or indirectly by sewage from a population of nearly 1,500 persons.

The pollution of Great South bay, from Patchogue eastward, is inconsiderable.

P82 X 83

11

Babylon

Great Cove

East Islip

Great River

Connetquot River

Patchogue Bay

GREAT SOUTH BAY

FIRE ISLAND

Oak Island Beach

Fire Island Inlet

ATLANTIC OCEAN

NEW YORK
STATE DEPARTMENT OF HEALTH
EUGENE H. PORTER, M.D.
Commissioner

SHELLFISH INVESTIGATION
1908

Scale 1/22,500
1 mile

LEGEND:-
- Leased Oyster Bed
- (66.) Public sewer system outlet
- (66.) Private sewer outlet
- (66.) Combined overflow pipe outlet
- (66.) Privy
- Number to left of decimal is No. of Inspectors report. Sub No. gives total No. of cases
- O—66/ Water Sampling Station
- Ebb Tide when sample was taken
- Flood " "
- O—662 Oyster Sampling Station. Number to left of decimal is No. of Sanitary Analysis

Exhibit No. 18

182 *Oyster Cultivation District No.* 11.

Great South Bay from Babylon to Patchogue.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Howell Point.....	185.2	.....	.....	1+3—	.....	.....
Patchogue	184.1	180	1+1—	0+2—	0+2—	.....
	184.2	.....	.....	.....	3+2—	.....
	186.2	.....	.....	1+2—	1+2—	.....
	188.1	700	2+0—	0+2—	0+2—	.....
	187.2	.....	.....	.....	4+0—	1+3—
	180.1	35,000	2+0—	2+0—	.....	.....
	180.2	.....	.....	.....	4+0—	4+0—
	181.2	.....	.....	3+0—	3+0—	.....
	183.1	19,500	2+0—	1+1—	0+2—	.....
	182.2	.....	.....	3+0—	1+2—	.....
Blue Point.....	189.2	.....	.....	0+4—	.....	.....
Green Point.....	190.2	.....	.....	2+2—	.....	.....
	191.2	.....	.....	1+3—	.....	.....
	200.2	.....	.....	1+3—	.....	.....
	193.2	.....	.....	1+3—	.....	.....
	192.2	.....	.....	0+4—	.....	.....
Nicholls Point....	194.2	.....	.....	2+2—	.....	.....
	195.2	.....	.....	1+3—	.....	.....
Islip	196.2	.....	.....	4+0—	.....	.....
	197.2	.....	.....	0+4—	.....	.....
	198.2	.....	.....	0+4—	.....	.....
	199.2	.....	.....	1+3—	.....	.....

(Here follows Exhibit marked No. 11.)

12. Hempstead Bay from Far Rockaway to Seaford Creek.

This district includes all the bays and creeks inside the ocean beach opposite the town of Hempstead. The oyster beds are located along the deeper channels over the greater portion of this area.

At the extreme westerly end of the district, oysters are cultivated in the upper reaches of broad channel and in the tributary leads and channels. In the easterly section, the beds are found in various channels from Cinder creek and Middle bay east to Great Island channel.

The oyster grounds in this district are maturing grounds, and the principal shipping points are at Woodmere, East Rockaway, Milburn and Freeport.

The pollution consists of discharge from private and party sewers from overflowing cesspools and from privies. No public sewer systems discharge into the waters of Hempstead bay.

East of the village of Far Rockaway, Bannister creek receives sewage from fifteen cottages through a party sewer, from two private sewers and from eight overflow pipes from cesspools, and the total population represented being 125.

883 At the westerly end of Hick's beach, nineteen cottages are served by a party sewer. Brosewere bay receives the overflow from the cesspool at the Rockaway Hunting Club, and in addition eight cottages have privies discharging into the water.

At East Rockaway, three private sewers discharge into the creek and six privies are so situated as to possibly cause pollution of the waters.

At Long Beach, a sewer serving twenty cottages or 100 persons, discharges in the summer season on to the marshes and may cause some pollution of the waters. About fifty privies along this beach are so situated that some pollution of the waters of Broad channel might result.

In addition, two privies are located along Broad channel, two along Post Lead and ten on Blackbank Hassock.

The foregoing comprises a statement of all the pollution which might affect the oyster beds in the westerly portion of Hempstead bay.

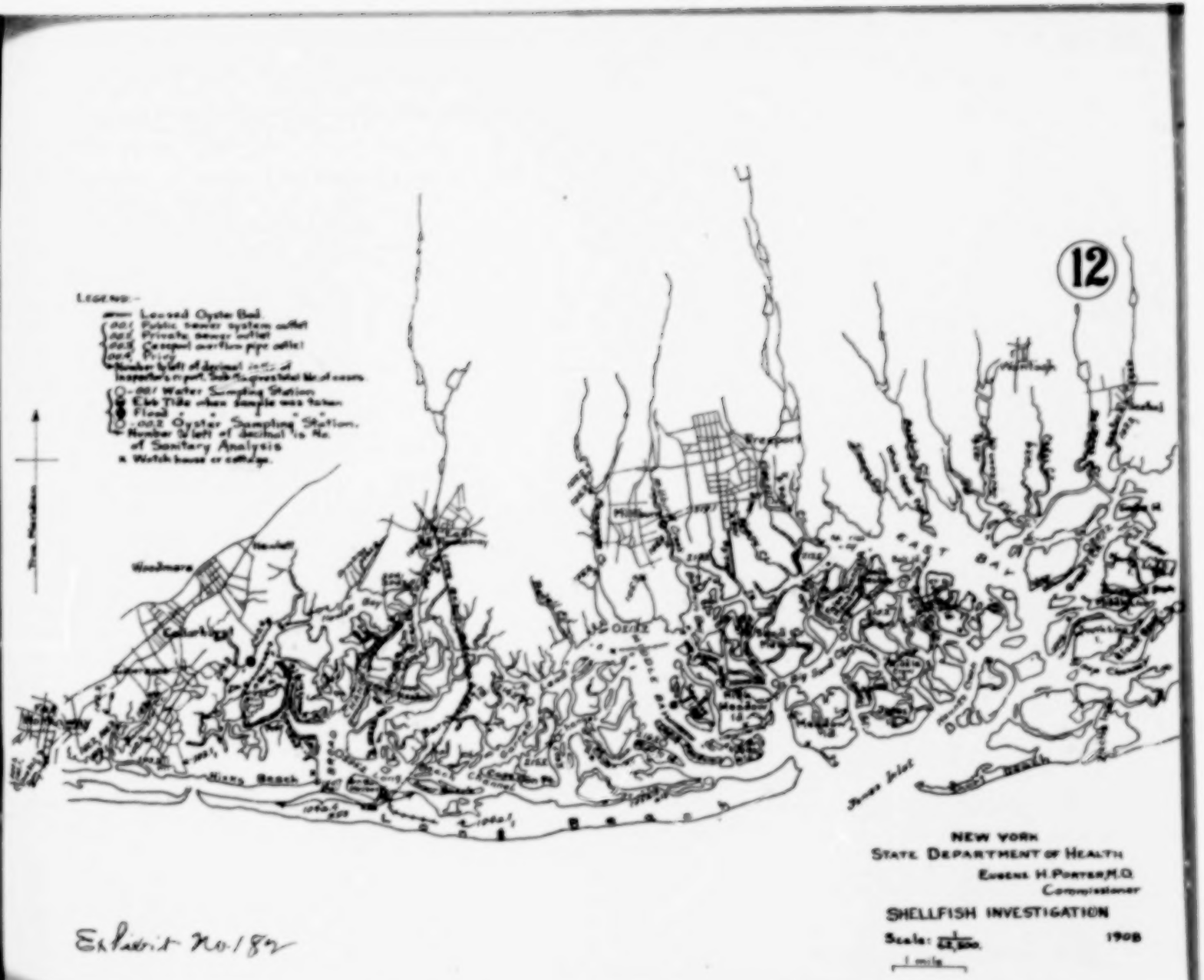
There are about twelve or fourteen oyster dealers at Woodmere dock, and shipments from this point may reach 15,000 to 20,000 bushels per year. About eight oyster-houses are located at East Rockaway. It is estimated that about 40,000 bushels per year are shipped from the grounds in Hempstead bay, west of the Long Beach railroad.

The drinking places in this section are at Hewlett creek and in two streams at East Rockaway.

At Hewlett creek, no pollution occurs in the immediate neighborhood of the drinking places.

At the main stream in East Rockaway, eight houses are located and very little pollution of the stream occurs.

A branch creek to the east of the village on which is located one oyster-house at which drinking is done is polluted by two privies



upstream from the house, one discharging directly. Also, two privies a short distance downstream pollute the waters.

The easterly section of Hempstead bay receives comparatively little pollution.

The three streams near Milburn are polluted by discharge from one private sewer, five overflow pipes from cesspools and five privies, representing a population of about fifty persons. The nearest oyster beds are a mile to the south in Middle bay.

884 At Freeport no direct sewage discharge occurs.

The only pollution of the waters is from one cesspool overflow and twelve privies on the three streams near the village. The pollution of Hempstead bay from this point eastward is also very slight. On Jackson creek are located two privies. On Cedar creek, one privy is located and Seaford creek receives sewage from one private sewer.

In addition to the pollution thus far noted, the easterly portion of Hempstead bay receives pollution from fifteen privies at Nassau-by-the-Sea near Point Lookout L. S. Station, and from privies at watchhouses and cottages located near oyster beds at the following points: One along Scow creek, one along Cinder creek, three on Alder and High Meadow islands, five adjacent to Long creek, one or two near False channel and Neds meadow, five along Broad channel, none direct, five along Great Island channel, three along South Line Island channel.

The drinking places along this section of Hempstead bay are at Milburn creek and Freeport creek and only very slight pollution from two doubtful privies in each case is possible. About 80,000 bushels of oysters per year are shipped from this section, making the total output from Hempstead bay about 120,000 bushels per year.

Oyster Cultivation District No. 12.

Hempstead Bay from Far Rockaway to Seaford Creek.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Freeport	207.2	.....	.....	0+4—	.....	.....
	208.2	.....	.....	4+0—	.....	.....
	209.2	.....	.....	0+4—	.....	.....
	210.2	.....	.....	1+3—	.....	.....
	211.2	.....	.....	4+0—	.....	.....
	217.2	.....	.....	1+3—	.....	.....
	212.2	.....	.....	3+1—	2+2—	.....
Milburn	218.2	.....	.....	3+1—	.....	.....
	219.1	9,000	2+0—	0+2—	0+2—	.....
	213.2	.....	.....	3+1—	.....	.....
	216.2	.....	.....	3+1—	.....	.....
	215.2	.....	.....	2+2—	.....	.....
	214.2	.....	.....	1+3—	.....	.....
Far Rockaway	201.1	900	2+0—	2+0—	2+0—	.....
	204.1	230	1+1—	2+0—	0+2—	.....
	204.2	.....	.....	2+2—	.....	.....
	206.2	.....	.....	4+0—	.....	.....
	203.2	.....	.....	3+1—	.....	.....
	202.2	.....	.....	3+1—	.....	.....
	205.2	.....	.....	2+2—	.....	.....

(Here follows Exhibit marked No. 12.)

885 13. Jamaica Bay (Brief Statement of Conditions).

The oyster beds in Jamaica bay, which is the largest oystering district in New York State waters, are leased by the State. Nearly every portion of the bay is occupied to some extent by oyster beds, although the industry is carried on most extensively west of the Rockaway Beach railroad. The maps accompanying this report show the location of all beds leased by the State in Jamaica bay. There are many beds shown on the maps including some near Rockaway Beach and the northeasterly end of Big channel that are not being used for oyster cultivation at the present time.

The principal shipping points on Jamaica bay are at Canarsie, Inwood and near Flatbush bay, although the greater portion of the trade is handled by schooners going directly from the beds to the New York market.

The yield of market oysters from Jamaica bay probably ranges from 500,000 to 1,000,000 bushels yearly.

The principal points of pollution are at the four sewage disposal plants at Sheepshead Bay, East New York, Jamaica and Far Rockaway, at the outlet of the Paerdegat and Kings county hospital sewers into Paedegat basin, at Bergen Beach, at Canarsie and along Rockaway Beach district. In addition to these points pollution reaches the bay from various summer cottage colonies, the principal colonies being located at Plum Beach, at Sand Bay, east of Canarsie, along Mill creek, at Ramblersville or Remsen Landing, along Bergen and Cornell creeks, and at the several stations on the bay of the Rockaway Beach railroad.

The pollution differs greatly at most points in the summer and winter seasons. The Sheepshead Bay disposal plant, using the chemical precipitation method, which the other three plants also use, receives sewage from a normal population of 2,000 in winter to a summer population of 40,000 to 50,000 on special days. The treatment is practically ineffective.

Bergen Beach is visited by from 50,000 to 60,000 persons weekly in summer, and the sewage, from an average of 8,000 persons daily, is discharged into the bay.

Paerdegat basin receives sewage from a permanent population of over 10,000 persons.

886 Canarsie is visited by an average of 16,000 persons daily in the summer season, including 30,000 on Sundays, and practically all the sewage from this population reaches the bay.

A permanent population of considerably over 50,000 persons contribute sewage to the New Lotts or East New York disposal plant. An average of 10,000,000 gallons of sewage and storm water per day is pumped at this plant, and in addition a relief by-pass is in operation from eleven o'clock a. m. until midnight. The plant is so much overtaxed, the sewage being detained for only seventeen to twenty minutes, that the treatment is practically ineffective.

At Sand Bay, 127 cottages, at Old Mill creek, 176 cottages, at Ramblersville, 220 cottages, at Bergen creek, 50 cottages, at Cornell

creek, 53 cottages, and along the line of the Rockaway Beach railroad over 200 cottages have privies which discharge into the water or onto marshes subject to tidal overflow.

The Jamaica disposal plant, effluent from which is discharged into a branch of Bergen creek, treats the sewage from about 18,000 persons out of a total population of 25,000 in Jamaica. The plant has ample capacity as a chemical precip-ation plant, although, under the best of operating conditions, a reduction of organic matter and bacteria of about 50 per cent. only is possible.

The Far Rockaway disposal plant receives sewage from a normal population of 6,500 and a summer population of 30,000. During the summer season, the plant is undoubtedly overtaxed.

The Rockaway Beach district varies greatly in population. In the winter season, from October to June, the population is about 6,000 as based on the registration. During the summer season the average daily population is from 55,000 to 60,000, and on a conservative estimate, based on the traffic figures of the railroad and steamboat lines carrying passengers to this district, the population in this district on certain days may reach as high as 125,000 to 150,000.

Twenty-nine public sewers discharge sewage from this varying population directly into Jamaica bay.

887 *Oyster Cultivation District No. 13.*

Jamaica Bay.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.	0.001 c. c.
Flat Lands.....	118.1	1,000	.....	.....	1+1—	0+2—	.....
Old Mill Pond..	118.2	.....	.....	.....	0+4—	0+4—	.....
	119.1	900	.....	.....	0+2—	0+2—	.....
	119.2	.....	.....	.....	1+3—	0+4—	.....
	120.1	500	.....	.....	0+2—	0+2—	.....
	120.2	.....	.....	.....	0+4—	0+4—	.....
Flat Lands Bay	80.1	1,800	2+0—	0+2—	.....	.....	.....
	80.2	.....	.....	6+0—	.....	.....	.....
	123.2	.....	.....	.....	0+5—	.....	.....
	81.1	5,700	2+0—	0+2—	.....	.....	.....
	81.2	.....	.....	6+0—	.....	.....	.....
	124.2	.....	.....	.....	0+5—	.....	.....
	82.1	2,900	1+0—	0+2—	.....	.....	.....
	82.2	.....	.....	6+0—	.....	.....	.....
	125.2	.....	.....	.....	0+5—	.....	.....
	83.1	3,600	0+2	1+1—	.....	.....	.....
	83.2	.....	.....	6+0—	.....	.....	.....
	126.2	.....	.....	.....	0+5—	.....	.....
	84.1	5,900	2+0—	1+1—	.....	.....	.....
	84.2	.....	.....	6+0—	.....	.....	.....
	127.2	.....	.....	.....	0+5—	.....	.....
	85.1	3,500	0+2—	0+2—	.....	.....	.....
	85.2	.....	.....	6+0—	.....	.....	.....
	128.2	.....	.....	.....	0+5—	.....	.....
Big Channel....	143.2	.....	.....	0+4—	0+4—	.....	.....
	106.2	.....	.....	4+0—	3+1—	.....	.....
	91.2	.....	.....	6+0—	.....	.....	.....
	6.1	12,500	.....	3+0—	4+0—	.....	.....
	11.1	3,600	.....	3+0—	4+0—	.....	.....

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.	0.001 c. c.
	107.2	.....	.....	3+1—	2+2—	.....	.....
	5.1	4,300	.....	3+0—	2+2—	.....	.....
	108.2	.....	.....	4+0—	4+0—	.....	.....
	12.1	1,900	.....	3+0—	4+0—	.....	.....
	109.2	.....	.....	1+3—	1+3—	.....	.....
	110.2	.....	.....	3+1—	2+2—	.....	.....
	3.1	15,500	.....	3+0—	4+0—	5+0—	.....
	14.1	2,200	.....	3+0—	3+0—	0+4—	.....
	112.2	.....	.....	4+0—	3+1—	.....	.....
	4.1	13,500	.....	3+0—	4+0—	.....	.....
	13.1	4,600	.....	3+0—	4+0—	.....	.....
	15.1	3,100	.....	.....	3+0—	2+2—	.....
	2.1	19,000	.....	.....	3+0—	4+0—	.....
	1.1	17,500	.....	.....	3+0—	4+0—	.....
	16.0	180,000	.....	.....	3+0—	4+0—	.....
Beds near Rockaway and Trestle	19.1	9,800	.....	1+2—	0+5—	.....	.....
	113.2	.....	.....	.....	4+0—	0+4—	.....
	167.2	.....	.....	.....	3+1—	3+1—	.....
	18.1	22,500	.....	2+1—	3+2—	.....	.....
	114.2	.....	.....	.....	4+0—	4+0—	.....
	115.2	.....	.....	.....	4+0—	3+1—	.....
	170.2	.....	.....	.....	3+1—	0+4—	.....
	116.2	.....	.....	.....	4+0—	2+2—	.....
	168.2	.....	.....	.....	3+1—	2+2—	.....
	169.2	.....	.....	.....	3+1—	0+4—	.....
	171.2	.....	.....	.....	3+1—	3+1—	.....
Ruffle Bar.....	22.1	2,000	.....	0+4—	.....	.....	.....
	74.2	.....	.....	6+0—	.....	.....	.....
	145.2	.....	.....	.....	2+2—	0+4—	.....
	75.2	.....	.....	6+0—	.....	.....	.....
	146.2	.....	.....	.....	0+4—	0+4—	.....
	87.2	.....	.....	6+0—	.....	.....	.....
	152.2	.....	.....	.....	1+3—	0+4—	.....
	88.2	.....	.....	5+0—	.....	.....	.....
	153.2	.....	.....	.....	0+4—	0+4—	.....
	41.1	700	.....	0+4—	.....	.....	.....
Big Fishkill Channel	76.2	.....	.....	5+0—	.....	.....	.....
	147.2	.....	.....	.....	3+1—	1+3—	.....
	8.1	4,200	.....	3+0—	5+0—	.....	.....
	9.1	8,600	.....	3+0—	3+0—	.....	.....
888							
Pumpkin Patch Channel	77.2	.....	.....	6+0—	.....	.....	.....
	148.2	.....	.....	.....	1+3—	0+4—	.....
	78.2	.....	.....	6+0—	.....	.....	.....
	149.2	.....	.....	.....	1+3—	0+4—	.....
Goosekill Creek.	21.1	18,500	.....	1+2—	0+5—	.....	.....
	79.2	.....	.....	5+1—	.....	.....	.....
	150.2	.....	.....	.....	0+4—	0+4—	.....
The Raunt.....	86.2	.....	.....	5+0—	.....	.....	.....
	151.2	.....	.....	.....	0+4—	0+4—	.....
	172.2	.....	.....	.....	3+1—	0+4—	.....
Big Channel (Old Swale Marsh)	89.2	.....	.....	5+0—	.....	.....	.....
	144.2	.....	.....	.....	1+3—	0+4—	.....
Island Channel.	7.1	44,000	.....	3+0—	4+0—	.....	.....
	90.2	.....	.....	4+1—	.....	.....	.....
	154.2	.....	.....	.....	0+4—	0+4—	.....

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.	0.001 c. c.
Tabulation of all analytical results of Jamaica Bay water samples	1.1	17,000	.....	.....	3+0—	4+0—	.....
	2.1	.....	.....	.....	3+0—	4+0—	.....
	3.1	15,500	.....	3+0—	4+0—	5+0—	.....
	4.1	13,500	.....	3+0—	4+0—	.....	.....
	5.1	4,300	.....	3+0—	2+2—	.....	.....
	6.1	12,500	.....	3+0—	4+0—	.....	.....
	7.1	44,000	.....	3+0—	4+0—	.....	.....
	8.1	4,200	.....	3+0—	5+0—	.....	.....
	9.1	8,600	.....	3+0—	3+1—	.....	.....
	10.1	56,000	.....	3+0—	4+0—	.....	.....
	11.1	3,600	.....	3+0—	4+0—	.....	.....
	12.1	1,900	.....	3+0—	4+0—	.....	.....
	13.1	4,600	.....	3+0—	4+0—	.....	.....
	14.1	2,200	.....	3+0—	3+0—	0+4—	.....
	15.1	3,100	.....	.....	3+0—	2+2—	.....
	16.1	180,000	.....	.....	3+0—	4+0—	.....
	17.1	24,500	.....	3+0—	1+3—	.....	.....
	18.1	22,500	.....	2+1—	3+2—	.....	.....
	19.1	9,800	.....	1+2—	0+5—	.....	.....
	20.1	5,000	.....	0+3—	0+5—	.....	.....
	21.1	15,500	.....	1+2—	0+5—	.....	.....
	22.1	2,000	.....	0+4—	.....	.....	.....
	23.1	50	.....	0+4—	.....	.....	.....
	24.1	1,900	.....	0+4—	.....	.....	.....
	25.1	100	.....	0+4—	.....	.....	.....
	26.1	50	.....	0+4—	.....	.....	.....
	27.1	1,500	.....	0+4—	.....	.....	.....
	28.1	7,600	.....	.....	.....	.....	.....
	29.1	4,200	.....	.....	2+1—	1+2—	.....
	30.1	1,800	.....	.....	2+3—	.....	.....
	31.1	7,200	.....	3+1—	.....	.....	.....
	32.1	500	.....	1+3—	.....	.....	.....
	33.1	35,000	.....	0+4—	.....	.....	.....
	34.1	100	.....	0+4—	.....	.....	.....
	35.1	3,900	.....	0+4—	.....	.....	.....
	36.1	1,100	.....	0+4—	.....	.....	.....
	37.1	1,100	.....	1+3—	.....	.....	.....
	38.1	1,100	.....	1+3—	.....	.....	.....
	39.1	5,200	.....	1+3—	.....	.....	.....
	40.1	250	.....	1+3—	.....	.....	.....
	41.1	700	.....	0+4—	.....	.....	.....
	111.1	49,000	.....	.....	0+2—	2+0—	1+1—
Shipping Points.	252.1	1,700	2+0—	0+2—	0+2—	.....	.....
Flat Lands	253.1	850	1+1—	1+1—	0+2—	.....	.....
Indian Creek..	254.1	1,000	2+0—	2+0—	.....	.....	.....
	255.1	1,500	2+0—	2+0—	4+0—	.....	.....

889 14. Raritan Bay (Brief Statement of Conditions).

Oyster grounds in Raritan bay are leased by the State. The beds are principally located from Great Kills west to Tottenville and reach nearluy half across the bay. West of Seguine Point, it is stated, the beds are used as propagating ground and no oysters are taken to be marketed from these beds.

The annual output from beds in Raritan bay, is estimated to be from 450,000 to 500,000 bushels and is sold principally in the New York market.

It is generally stated that the ebb tide coming out of the Narrows and swinging toward Raritan bay meets the ebb from Raritan bay at points to the northeast of Elm Tree beacon, so that the sewage discharged from New York city does not under ordinary conditions pass over the oyster grounds in Raritan bay during ebb tide.

Briefly, the sewage pollution of Raritan bay is as follows:

At Tottenville a population of 2,000 is served by a public sewer system having four outlets into Arthur Kill and Raritan bay.

From Ward Point to Red Bank, nine private sewers and one privy pollute the waters.

At Red Bank, a Catholic mission with 2,000 inmates discharges sewage directly into the bay.

At Seguine Point, a dental goods manufacturing company, employing 600 hands, discharges all sewage directly into the bay.

There are also three private sewers serving ten houses, and two privies on Princess bay and Lemon creek which pollute the waters directly.

East of Seguine Point, a large hotel with a capacity of 200 has practically a direct sewer to the bay. Three private sewers and one cesspool overflow also pollute the waters of the bay near Latourette pond. A short distance west of Great Kills, three private sewers discharge into the bay. At Great Kills one hotel discharges into a small stream and one discharges direct. Three other private sewers and two privies pollute the waters of Great Kills.

West of Midland Beach, a hospital with 300 inmates and attendants discharges sewage directly into the bay as well as a hotel with a capacity of fifty.

890 At Midland Beach, all the sewage is discharged into trenches in the meadows just back of the resort. Three hotels and a number of cottages are connected to the main sewer. This is a large summer resort and undoubtedly some of the sewage would reach the bay.

At South Beach, sewage from a summer resort visited by 1,000 persons a week is discharged directly into the bay.

Pollution Reaching Raritan Bay from New Jersey Municipalities.

The Raritan river in New Jersey receives considerable sewage pollution, the description of which follows:

At its mouth, approximately one-third of the sewage from 27,000 persons at Perth Amboy is discharged into the Raritan, and the rest into Arthur Kill. South river, a tributary of the Raritan, receives pollution from sixty-five private houses.

New Brunswick, population 23,000, discharges sewage direct but is under notice from the New Jersey State Board of Health to cease polluting the river by July, 1911.

Highland Park, population 714, discharges direct but will be required to treat sewage by July, 1911.

Bound Brook, population 4,000, and New Bound Brook, population 1,000, both discharge sewage direct, but are under orders to cease such discharge by July, 1911.

Somerville, population 5,000, discharges directly, but is to treat sewage by July 1, 1911.

Raritan, population 3,500, discharges directly.

Flemington has a septic tank and sand filters and takes water at Flemington Junction with no filtration. No considerable pollution occurs on Millstone river.

Green brook, a tributary stream to Bound brook and the Raritan, receives sewage directly from Lincoln, population 300.

At Plainfield, septic tank and secondary contact bed treatment are in use.

The Rahway river, discharging into Arthur Kill about eight miles from Raritan bay, receives sewage from Rahway, population 8,650, and Cranford, population 3,600. Both these boroughs must cease polluting the river by November 11, 1911.

891 Below Rahway, the State reformatory with 1,000 inmates discharges sewage into a septic tank and the effluent after passing over mud flats reaches the Rahway river. Plans to install sand filters are under way.

The Orange joint trunk sewer discharging into Arthur Kil. serves a population of 25,000 to 30,000, and Elizabeth, population 60,000, discharges most of its sewage into Arthur Kill.

Roselle has population of 1,300 connected with sewage discharging into Morse creek, a tributary of Arthur Kill.

The town of Linden has twelve private sewers discharging into West brook.

The Shrewsbury river receives pollution by direct sewage discharge as follows: Sea Bright, population 1,160, has 200 private sewers, some hotel sewers and some joint or party sewers.

Red Bank, population 6,260, has septic tank and filters.

Atlantic Highlands, population 1,480 in winter and 2,000 in summer, discharges sewage direct into Raritan bay, but is to build septic tank by June 1, 1909.

The Waterwitch Club, population 1,000 in summer, have septic tank completed in August, 1908, and sand filters were to be installed during the fall of 1908.

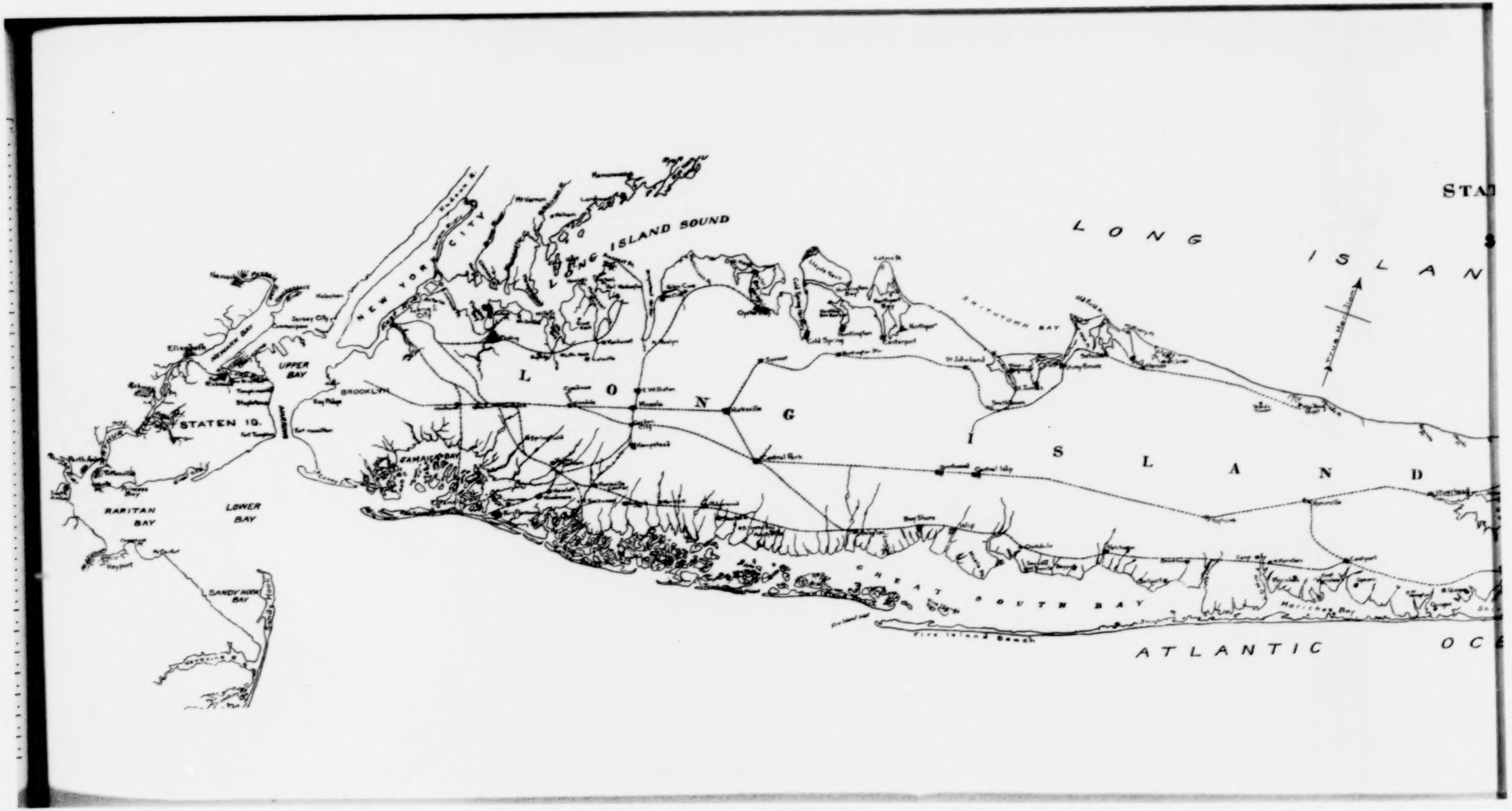
892 *Oyster Cultivation District No. 14.*

Raritan Bay.

	Sample number.	Bacteria per c. c.	Presumptive B. Coli.			
			10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
Raritan Bay Water	42.1	100	.....	0+2—	0+2—	0+2—
	43.1	1,100	.....	0+2—	0+2—	0+2—
	44.1	50	.....	0+2—	0+2—	0+2—
	45.1	400	.....	0+2—	0+2—	0+2—
	46.1	7,400	1+1—	0+2—	0+2—	.....
	47.1	.....	1+1—	0+2—	0+2—	.....
	48.1	1,100	2+0—	0+2—	0+2—	.....
	49.1	700	1+1—	1+1—	0+2—	.....
	50.1	200	0+2—	1+1—	0+2—	.....
	51.1	4,000	0+2—	0+2—	0+2—	.....
	52.1	2,500	2+0—	0+2—	0+2—	.....

	Sample number.	Bacteria per c. c.	Presumptive B. Coli. 10 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.
	53.1	2,100	1+0—	0+2—	0+2—	.....
	54.1	1,700	0+1—	0+2—	0+2—	.....
	55.1	4,000	.....	0+2—	0+2—	.....
	56.1	9,100	.....	0+2—	1+1—	.....
	57.1	3,600	.....	0+2—	0+2—	.....
	58.1	2,400	.....	1+1—	0+2—	.....
	59.1	1,100	.....	2+0—	0+2—	.....
	60.1	3,600	.....	1+1—	0+2—	.....
	61.1	1,400	.....	1+1—	0+2—	.....
	67.1	2,000	2+0—	0+2—	0+2—	.....
	69.1	210	0+2—	2+0—	0+2—	.....
	95.1	240	.....	1+1—	0+2—	.....
	99.1	130	.....	0+2—	0+2—	.....
	62.2	.....	.....	4+2—	.....	.....
	161.2	.....	.....	.....	1+3—	0+4—
	63.2	.....	.....	5+1—	.....	.....
	162.2	.....	.....	.....	4+0—	3+1—
	64.2	.....	.....	6+0—	.....	.....
	155.2	.....	.....	.....	2+2—	0+4—
	65.2	.....	.....	6+0—	.....	.....
	141.2	.....	.....	.....	0+5—	.....
	66.2	.....	.....	6+0—	.....	.....
Great Kills and vicinity	156.2	.....	.....	0+4—	0+4—	0+4—
	72.2	.....	.....	3+3—	.....	.....
	140.2	.....	.....	.....	0+5—	.....
	73.2	.....	.....	5+1—	.....	.....
	142.2	.....	.....	.....	2+3—	.....
	92.2	.....	.....	4+1—	1+4—	.....
	131.2	.....	.....	.....	2+3—	.....
	93.2	.....	.....	4+1—	.....	.....
	132.2	.....	.....	.....	1+4—	.....
	94.2	.....	.....	3+2—	1+1—	.....
	133.2	.....	.....	.....	2+3—	.....
	134.2	.....	.....	.....	0+5—	.....
	96.2	.....	.....	5+0—	.....	.....
	135.2	.....	.....	.....	2+0—	.....
	97.2	.....	.....	4+1—	.....	.....
	136.2	.....	.....	.....	0+5—	.....
	98.2	.....	.....	5+0—	.....	.....
	137.2	.....	.....	.....	3+2—	.....
	99.2	.....	.....	2+3—	.....	.....
	138.2	.....	.....	.....	1+4—	.....
	100.2	.....	.....	5+0—	.....	.....
	159.2	.....	.....	.....	0+4—	0+4—
	101.2	.....	.....	5+0—	.....	.....
	160.2	.....	.....	.....	0+4—	0+4—
	70.2	.....	.....	3+1—	0+2—	.....
	158.2	.....	.....	.....	0+4—	0+4—
	68.2	.....	.....	6+0—	.....	.....
	157.2	.....	.....	.....	1+3—	0+4—
	71.2	.....	.....	5+0—	1+1—	.....
	163.2	.....	.....	.....	0+4—	0+4—
	102.2	.....	.....	5+0—	.....	.....
	164.2	.....	.....	.....	0+4—	0+4—
	103.2	.....	.....	5+0—	2+0—	.....
	165.2	.....	.....	.....	2+2—	0+4—
	104.2	.....	.....	5+0—	.....	.....
	166.2	.....	.....	.....	4+0—	1+3—

(Here follow exhibits marked No. 0, Nos. 8, 9, 10, and No. 13.)


LONG ISLAND SOUND
NEW YORK CITY
LONG ISLAND
STATEN IS.
BROOKLYN
UPPER BAY
LOWER BAY
RARITAN BAY
SANDY HOOK BAY
Sandy Hook
JAMAICA BAY
SMITHTOWN BAY
GREAT SOUTH BAY
Fire Island Beach
ATLANTIC OCE

8924

NEW YORK
STATE DEPARTMENT OF HEALTH
EUGENE H. PORTER, M.D.
Commissioner

SHELLFISH INVESTIGATION
1908

Scale: 1/250,000

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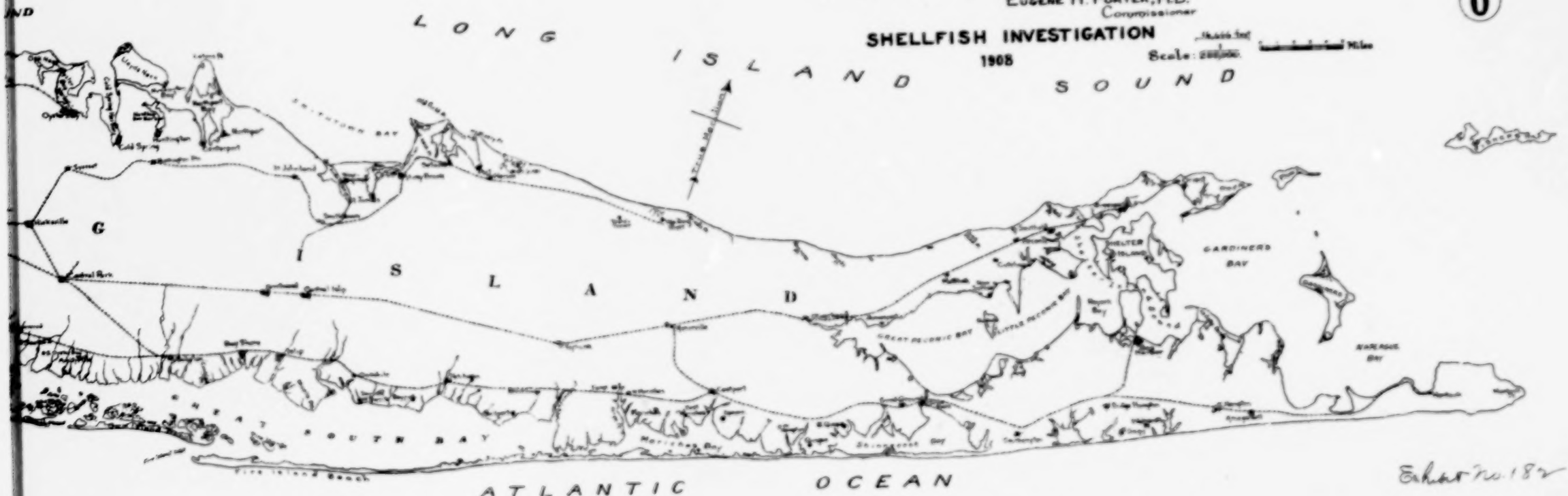

Chart No. 182

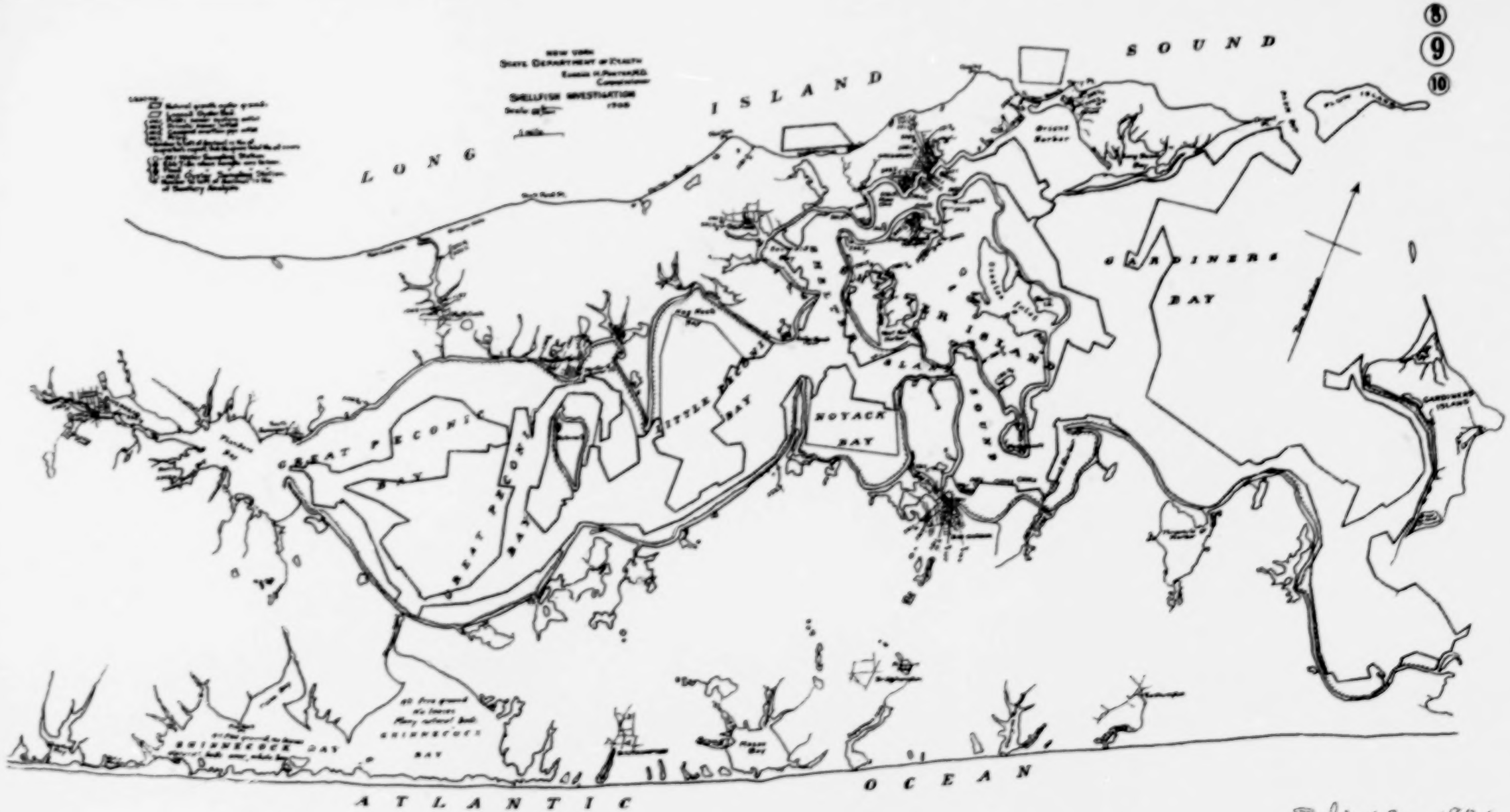

Exhibit No 182